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[(list of 106 states)]

Title: Device for conveying products between different workstations.

ABSTRACT

[English Abstract supplied.]

linear motor = linear drive.

position magnet = position-signaling magnet (32).

position acknowledgment = position-indicating signal.

[Specification:]

EP-B-316,990 discloses an apparatus for conveying product, depositing product units in rows, and pushing product into a delivery station. The apparatus comprises a rotary belt which bears a plurality of cup-shaped pans which can be retained at a receiving station or a delivery station by means of a respective mechanical retaining device. This known apparatus has the disadvantages that its mechanical drive means and synchronization means are costly and susceptible to malfunction.

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The underlying problem of the present invention is to avoid the above-described disadvantages. This problem is solved by the combination of features set forth in the claims.

An exemplary embodiment of the invention [sic -- i.e. two embodiments] will be described hereinbelow, with reference to the drawings.

[Translator's note: The drawings referred to here are evidently those marked "Revised" ("Ersatzblatt").]

Fig. 1 is a schematic plan view of the apparatus;

Fig. 2 is a schematic lateral view;

Fig. 3 is an enlarged detail of Fig. 2, without the guide;

Fig. 4 is a cross section through IV-IV in Fig. 3;

Fig. 5 is a lateral view of the coils;

Figs. 6 and 7 are a transverse cross section and a

longitudinal cross section through the coils and the permanent magnets;

Fig. 8 is a lateral view of the coils in the direction-change region; and

Fig. 9 is a cross section through a second embodiment.

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The apparatus 1 according to Fig. 1 extends between a receiving station 2 and a delivery station 3. At receiving station 2, product units 5 serially arriving from a conveyor belt 6 are loaded onto respective carriages 4 for said product. The product units 5 on the belt 6 arrive [at receiving station 2] at nonuniform spacings (t1, t2). The carriages 4 are individually advanceable on a guide 7. A photocell detection device 8 is provided, at least at the downstream end of the conveyor 6. When a product 5 is sensed by the photocell device 8, the conveyor 6 is stopped if no carriage is present at the receiving station 2. After the product 5 has been pushed onto the carriage 4 at receiving station 2, said carriage 4 is advanced toward the delivery station 3. At delivery station 3, the carriages are retained in groupings of, e.g., three carriages, and the product units 5 are expelled in said groups onto a removal conveyor belt 11 by a thrust member 10. As soon as a group 14 [of product units] has been expelled onto conveyor 11, conveyor 11 is advanced by one step-distance, whereby the product groups 14 can

be conveyed on conveyor 11 at uniform separations between groups, e.g. for feeding a packaging machine which packages multiple product units. The emptied carriages 4 are returned to the receiving station 2 by return means.

Fig. 2 is a schematic lateral view of the apparatus 1. The guide 7 comprises a guideway in the form of a vertical closed loop the operating stretch of which is the upper horizontal straight-line stretch 21. The lower straight stretch 22 is the return stretch; and the two semicircular stretches 23 join said upper and lower stretches. The guide 7 is divided into a plurality of segments 24. Each of the straight segments 24 has, e.g., twelve [(electromagnetic)] air-core coils 25 sequentially disposed, wherewith

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the coil axes of said coils are perpendicular to the plane of the guide 7 [sic -- evidently parallel to said plane and transverse to the conveying direction (see Fig. 4)]. Each segment 24 has an associated control unit 26 which controls the individual coils 25 of said segment. Each carriage 4 has at least one permanent magnet 27 (Fig. 3) on [each of] its sides [(Fig. 4)] facing the coils 25, which magnet(s) interact(s) with the coils 25 to form a linear drive. The permanent magnets 27 are interconnected by a U-shaped soft iron yoke 28 (Fig. 4) which extends around the coils 25 on the upper side of said coils. The gap between the

coils 25 and permanent magnets 27 is narrow, e.g. c. 1 mm. The carriages 4 are guided by rails 31 of the guideway 7, via four support wheels 29 and two lateral guide wheels 30.

Each carriage 4 also has a small position-signaling magnet 32 which interacts with a row of linear Hall effect sensors 33 on the guide 7, which sensors may be uniformly spaced, e.g. at intervals of c. 7 mm. By interpolation of the signals of neighboring sensors, the position of a carriage 4 can be accurately determined. The sensors 33 are also connected to the respective control units 26, which control units are all in turn controlled by a central control unit 34 [(Fig. 2)] which also receives signals from the photocell device 8. To accommodate the product 5, the carriages 4 have a flat [horizontal] platform surface 35 with vertical delimiting walls 36 which walls extend transversely to the conveying direction A.

As seen from Figs. 3 and 5, each coil 25 has the overall configuration of an elongated loop with relatively long

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straight side segments 40 joined by semicircular end segments 41. The coils are disposed in pairs overlappingly arranged in essentially a single row, wherewith a side segment 40 of one coil 25 in a pair is disposed between the two side segments 40 of the other coil 25 of said pair. In the region of the end segments 41, at least one of the coils 25 is bent out of the common plane

of the side segments 40 (Fig. 6). The coils 25 of a given [guide path] segment 24 are bonded together by, e.g., plastic resin, and are adhesively bonded to a common support plate 42 [(Fig. 4)] to which also the associated control unit 26 and sensors 33 are fixed.

On the operating stretch 21, where relatively high accelerations and decelerations of the carriages 4 are demanded, in order to attain high magnetic flux the width of the side segments 40 is only slightly less than the width of the included space between the side segments 40 of a given coil 25. On the return stretch 22 and in the semicircular stretches 23 the coils 25 can have a smaller cross section, as indicated by the [two coil configurations] shown in Fig. 8. Forced-flow cooling, e.g. air cooling, may be provided, particularly for the coils 25 in the operating stretch 21 where power output is high.

In operation, the central control unit 34 controls the movement of all carriages [25], such that:

-- a carriage 4 being loaded at station 2 is stationary;

-- during unloading at station 3 a group of carriages 4 are also stationary and disposed at a prescribed distance apart; and

-- between said stations the carriages 4 are moved with prescribed accelerations, decelerations, and minimal distances apart.

In this connection, the central control unit 34 generates set-

point values for the

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control units 26, and fine control of the carriages by the control units 26 is accomplished with the aid of the measurements of the actual positions [of the carriages] indicated by the signals from the sensors 33.

The apparatus is reliable and quiet in operation. Collisions between carriages can be reliably prevented, with the aid of synchronized electronic control. The apparatus can be easily changed to different modes of operation and, e.g., to different carriage lengths and numbers of carriages 4, by reprogramming the control system. The length of the operating stretch 21 can be changed easily by adding or removing segments 24. The apparatus is thus very flexible.

In the embodiment according to Fig. 9, each carrier has only one support member 28 bearing a single permanent magnet 27 or a series of permanent magnets 27. A chain of coils 25 is provided on each side of the support member 28; in this embodiment the coils are iron-core (47) rather than air-core coils. The control unit is comprised of a microprocessor board 48 and a power electronics board 49. The latter is connected to the coils 25 by one or more cables 50. The sensors 33 are connected to board 48 by one or more other cables 51. The carriages 4 are guided in the guideway 7 via guide elements, e.g. magnetic bearings (not

shown).

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[Original 13 claims, not translated here.]

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Amended claims, filed Jul 12, 1996 (replacing original claims):

1. An apparatus for conveying products (5) at times when they are needed, on an operating path (21) between different stations, particularly between a receiving station (2) and a delivery station (3), said apparatus comprised of a stationary guideway (7) for guiding the movement of a plurality of conveying elements (4) which accommodate product (5), which guideway is oriented in a vertical plane and is configured as a closed loop with a return stretch (22) disposed below the operating stretch (21),
wherewith a plurality of separately controlled coils (25) are sequentially disposed along the guideway,
wherewith each conveying element (4) has at least one permanent magnet (27) which together with the coils (25) forms a linear drive,
and wherewith a series of sequentially disposed position sensors (33) for measuring the positions of the conveying elements (4) are disposed on the guideway (7).

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2. An apparatus according to claim 1; wherein the conveying elements (4) [each] have a platform (35), and have side walls (36) extending transversely to the conveying direction.

3. An apparatus according to claim 1 or 2; wherein each conveying element (4) has a U-shaped support structure (28) having two leg members, wherewith at least one permanent magnet (27) is fastened to the inner side of each leg member, and wherewith the coils (25) form a comb structure which penetrates between said permanent magnets (27).

4. An apparatus according to claim 1 or 2; wherein each conveying element (4) has a plate-shaped support member (28) to which at least one permanent magnet (27) is fastened, wherewith a plurality of the coils (25) are disposed on each side of the support member (28), and wherewith the two rows (or sets) of coils (25) form a slot in which the support members (28) bearing the permanent magnets (27) extend.

5. An apparatus according to one of claims 1-4; wherein the guideway (7) has a straight operating stretch (21) and two curved stretches (23), with one such curved stretch adjoining each end of the operating stretch (21).

6. An apparatus according to one of claims 1-5; wherein a transmitter element (perturbing element) (32), preferably a relatively very small additional permanent magnet, is fixed to each conveying element (4), wherewith the position sensors (33) interact with said perturbing element (32).

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7. An apparatus according to one of claims 1-6; wherein each

coil (25) has two side segments (40) which are longer than their mean mutual separation.

8. An apparatus according to claim 7; wherein the permanent magnet (27) is shorter in the vertical direction than the lengths of the side segments [(40)] of the coils (25).

9. An apparatus according to one of claims 1-8; wherein the coils (25) are disposed in pairs which are overlappingly arranged [i.e. in which the coils of a pair overlap].

10. An apparatus according to one of claims 1-9; wherein, in at least one region of the guideway (7), particularly in the return stretch (22), the cross section of the coils (25) is less than in the operating stretch (21) of said guideway (7).

11. An apparatus according to one of claims 1-10; wherein the chain of coils (25) is comprised of at least two removable segments (24).

12. An apparatus according to one of claims 1-11; wherein each of the coils (25) has an iron core (47).

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Ger. 19535515 of Sep 25, 1995.
Applicant: Rovena Verpackungsmaschinen GmbH, of 35463 Fernwald, Germany.
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Title: Packaging apparatus.

ABSTRACT

In an apparatus 1 for packaging, comprised of a device 100 for acting against the product 8 to be packaged, or the packaging, or a part of the packaging, an electromagnetic linear drive means 63 is provided which has a movable part 4 and a driving part 5. The movable part 4 [lit., "5"] is connected to the said device (100).

The electromagnetic linear drive 63 allows accelerations to be achieved which are as great as 20 times the earth's gravitational acceleration, whereby very high packaging speeds can be attained.

(Fig. 8)

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Specification

The invention relates to an apparatus for packaging, comprised of a device for acting against the product to be packaged, or the packaging, or a part of the packaging.

Packaging devices are known which act against the product to be packaged, wherewith the product to be packaged is accelerated in a prescribed time cycle, for feeding of product to a packaging machine. Further, packaging devices in the form of tubular-bag-forming and filling machines are known, wherein the product to be packaged is accelerated for bringing about free fall of said product in a filling tube. [¶] Means of guiding and/or controlling the product during its movement are provided, which means may comprise, e.g., a conveyor belt, part of a conveyor belt, or (in the instance of a tubular-bag-forming and filling machine) a filling tube.

[[The following ¶, Col. 1 lines 21-32, is redundant:]] Apparatuses are known wherein a product to be packaged is introduced to a packaging machine by a conveyor belt driven by an electric motor. Also, devices in the form of tubular-bag-forming and filling machines are known wherein the product to be packaged is accelerated for bringing about free fall of said product in a filling tube. Means of guiding and/or controlling the product during its movement are provided, which means may comprise, e.g., a conveyor belt, part of a conveyor belt, or (in the instance of a tubular-bag-forming and filling machine) a filling tube.

Also, a flowable product, e.g. a powder or granulate, may be fed portionwise [to a packaging device] via a bifurcated volumetric dosing device, from a reservoir vessel. The product may be delivered, e.g., into a filling tube of a tubular-bag-forming and filling machine, from (or in) which tube the product is packaged portionwise into tubular film bags.

Packaging apparatuses comprised of a device for acting against the packaging or a part of the packaging have long been known. In a typical tubular-bag-forming and filling machine the bag seams are

welded by special welding/sealing devices. When product is loaded into a folding box, means are provided whereby the box flaps are folded-over and mutually fixed by adhesive. Electric motors are used as drive means for the welding/sealing devices.

Apparatuses having devices for separating packaging materials are also known. Such a device, e.g. in a tubular-bag-forming and filling machine, may employ, e.g., a punch knife or other cutting means to sever strip film material, so as separate-out a finished bag from a strip film [(or tubular film)], or to punch a hanging hole in the outer material of a bag.

Known apparatuses for feeding packaging materials may have materials-feeding devices in the form of film-advance means,

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a box-blank separator, a conveyor belt having cup-shaped compartments, a suction-cup device, or a device for dispensing and applying labels. The drive means for these materials-feeding devices are electric motors.

The known apparatuses have the drawback that they are too slow for high-speed movement or handling of product to be packaged, or of the packaging materials (or a part of same), to find use in high-speed packaging machinery. Also, many of the known mechanical linkages and transmissions are unsuitable for the transmission of very high forces (and speeds), because of their relatively high inertia (and moment of inertia). Further, known electrical motors are incapable of braking the high speeds (and accelerations) involved.

The underlying problem of the present invention is to devise an apparatus of the type described supra, wherein very high accelerations (and decelerations) are achievable. The mechanical linkages and transmissions in such an apparatus must be suitable to accommodate such high accelerations and decelerations.

This problem is solved by the features in the predicate of Claim 1, whereby an electromagnetic linear drive means is provided which has a movable part and a driving part, wherewith the movable part is connected to the device for acting against the product to be packaged,

or against the packaging or a part of the packaging.

The inventive apparatuses have the advantage that they enable accelerations (and decelerations) of up to twenty times the earth's gravitational acceleration. These accelerations are experienced by the movable part of an electromagnetic linear drive, relative to the driving part of said drive (or vice versa). Said movable part moves said device [for acting against the product or packaging], which device acts on said product or packaging either through direct contact or indirectly. In either case, the said acting device is accelerated by the linear drive and in turn accelerates the product or packaging (or accelerates an implement which acts on the product or packaging). The position of the linear drive is appropriately controlled for the said acceleration (and subsequent retraction, wherewith the [driving part] itself may be retracted). In the case of direct contact of the said acting device with the product, any intermediate mechanical linkage or transmission which might entail [additional] inertial lag is thereby obviated, and thus the movement (or acceleration) is imparted without involvement of substantial [additional] inertial mass (or inertial moment). The inventive apparatuses enable the realization of very high speed packaging machines.

Additional advantageous embodiments of the inventive apparatus are set forth in Claims 2-37.

If the movable part of the electromagnetic linear drive

-- Col. 3 --

is connected to a thrust member (Claim 2), maximum accelerations of the product are achievable, because the mass subjected to acceleration is minimized. If the thrust member acts indirectly on the product via a device for guiding (or conveying) the product being moved (Claim 3), a plurality of product units (disposed on or under the influence of said device for guiding or conveying) can be subjected to the acceleration [essentially simultaneously]. Said device for guiding or conveying may comprise a conveyor belt, which may be employed, e.g., to deliver a series of open bags to be filled, to a filling station, and then to a bag-sealing station. The entire stepwise conveying

process under such an arrangement can be driven by an electromagnetic linear drive.

A combination of two electromagnetic linear drives may be used to provide a combination of two mutually perpendicular accelerations. For this purpose, the driving part of one linear drive may be connected to the movable [(driven)] part of the other linear drive, wherewith the movable parts of the linear drives are moved in directions which are mutually perpendicular in a plane. Thus the first linear drive in executing a driven displacement [of its movable part] parallelly displaces the entire other linear drive [(including driving part and driven parts)] by the distance of said displacement; and thereby the combination of the two linear drives can displace a thrust member along an arbitrary path [in the plane in question] which path is limited [only] by the maximum excursions of said linear drives. Such a path may be, e.g., a parallelogram, a circle, or an ellipse.

If the device for guiding the movable part comprises the filling tube of a vertically oriented tubular-bag-forming and filling machine, then bulk materials, or doses or packets of materials, can be accelerated while in free fall, with accelerations greater than gravitational.

Box blanks which are intended to form interior boxes in bags, having the function of conferring shape, shape retention, and strength to the bag structure, can be inserted into respective bags via the filling tube of a tubular-bag-forming and filling machine, with the aid of a thrust member, wherewith the thrust member is moved downward into the tube from above. In such an arrangement, a delivery station for individual box blanks may be provided directly above said filling tube. The box blanks may be in a certain preliminary folding configuration and may be converted to a more advanced (or final) folding configuration by means of the resistance of the upper [sic] end of the filling tube.

It is possible that the thrust member is provided on a device which delivers product into free fall, and that said thrust member

acts downward in the space through which the product falls. Said delivery device may be, e.g. a damper or gate which releases a predetermined dose of product for movement downward, wherewith the thrust member may, e.g., act to urge the product dose downward and accelerate it along a downward path. The thrust member (possibly in another arrangement) may act from above, forcing out of the dosing device the product dose which has been prepared in said dosing device, wherewith after the

-- Col. 4 --

dosing device has been opened the thrust member may convey the product dose further, to the lower end of the filling tube. If the cross section of the thrust member is sealingly adapted to the open cross section of the filling tube, the thrust member will engage all of the product [in its path], including product aggregations [which may tend to adhere to the tube wall].

An alternative to a thrust member whihc is introduced into the filling tube from above and is subsequently retracted from said tube is a thrust member which is introduced into (and retracted from) the tube radially. In such an arrangement, the filling tube is not that of a customary vertical tubular-bag-forming and filling machine, because in such a machine the tubular material is guided on or along the filling tube; rather, the radial arrangement is useful for a filling tube for filling of pre-formed containers. One linear drive is oriented parallelly to the filling tube, and a second linear drive is oriented radially. The filling tube has an axially extending slot, at each end of which a respective tangential [i.e. peripheral] opening is provided in the filling tube. The thrust member is inserted into the filling tube through the first such opening, and is employed to accelerate the product downward, during which a rod whereby said thrust member is connected to the moving part of the [radially acting] linear drive is moved downward in the aforesaid slot; finally, the thrust member is withdrawn from the filling tube through the lower [peripheral] opening [provided therefor]. According to a refinement of this arrangement, which refinement in fact is applicable to a

tubular-bag-forming and filling machine, the shelf-like forming jig for forming the tubular bags is provided below the lower [peripheral] opening, the thrust member is in the form of a mesh or the like, wherewith an air space will not form below the thrust member; instead, the air can flow upward through the mesh.

If a device for guiding the product being moved is provided in the form of a horizontal conveyor belt, a horizontal thrust member may be oriented transversely to the conveyor belt, wherewith the thrust member acts toward a vertically [and longitudinally] extending limit element on (or for) the conveyor belt. With this arrangement, [the thrust member can be employed], e.g., to push a bag into a box, with the conveyor belt stopped (or moving at an appropriately slow speed), the box disposed against said limit element, and the bag disposed generally ahead of an opening in the box. Because the bag is inserted very rapidly, the driving part of the linear drive may be positionally fixed. A conveyor belt moving at continuously high speed can be accommodated by moving the linear drive (which pushes the bag), e.g. by attaching it to a second linear drive which moves the first linear drive reciprocally forward and back in a path parallel to the conveyor belt. Each time the first drive is moved in the forward conveying direction [by the second drive], a stroke of the first drive is executed whereby a bag is inserted into a box. After the retraction [(of both drives)], [the operation is repeated whereby] the next bag is pushed into a box.

A thrust member can also be employed according to the invention to remove defective products from a conveyor belt. The defective products are detected by a sensor, wherewith the measurement signal from [(or associated with)] the sensor serves to control the linear drive which drives the thrust member.

A horizontally acting thrust member may be employed, to deflect defective product from a free-falling product stream, in an arrangement wherein the thrust member is suitably disposed with respect to said stream and operates in conjunction with a sensor for detecting the defective product.

A thrust member may be employed to insert leaflets or other stable accompanying items into a folding box, wherewith the thrust member is in the form of an insertion head which operates transversely to a conveyor belt at a leaflet supply station.

If the movable part [of the linear drive] is connected to a closing and/or sealing mechanism (Claim 6), closing and/or sealing operations can be performed very rapidly.

If the closing/sealing mechanism is a welding device with two mutually opposed transverse welding dies, in a vertical tubular-bag-forming and filling machine, the dies can be moved very rapidly to produce the top- and bottom seams of a bag. An advantage is the accurate excursion of the dies, which enables close fitting of the dies to the configuration of the other parts of the welding station, and further enables combining the dies with other implements which can be borne by said dies, to accomplish additional functions [(e.g. cutting or punching)]. The two opposed dies may be accommodated (and brought together in opposed position) in an elementary sealing mechanism, wherein one transverse die is connected to the movable part of an electromagnetic linear drive, and the other transverse die is connected to the driving part of said drive. With this simple arrangement, additional [lag-susceptible] linkages and transmissions are obviated.

One electromagnetic linear drive is sufficient to drive a plurality of synchronous movements in the same or different directions. In this connection, a transmission employing pistons in a pressure-transmission device may be employed. A transverse welding device may have the movable part of an electromagnetic linear drive connected to a piston operating in a pressure-transmission device, wherewith the pressure-transmission medium in said pressure-transmission device transmits the pressure exerted by the linear drive via [driven] pistons to the transverse [welding] dies. If said medium is a liquid, the pressure transmission is relatively un-damped; if a gas, it is damped.

A closing and welding device at a transverse sealing station,

employing transverse welding dies, can produce lateral-fold bags very rapidly if (Claim 8) two lateral-fold-forming implements are provided at the transverse-die welding station, wherewith the drive

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for said fold-forming implements comprises at least one electromagnetic linear drive (said implements may be driven by a common such linear drive or by separate drives). The fold-forming implements form lateral folds in the bag material prior to the execution of the transverse welding.

High-speed bending-over of a projecting top- or bottom seam of a tubular bag can be accomplished rapidly and reliably if (Claim 9) the movable part of the electromagnetic linear drive is configured as an implement which causes the folding-over of the seam(s) of the bag; and in that a conveyor belt bearing cup-shaped compartments is provided for transporting bags having end seams to the location of said implement. The cup-shaped compartments ensure the stability of the bags during the folding-over of the said seams.

The closing and sealing device according to Claim 10 facilitates sealing of the bottom seams of tubular bags. The movable part of the electromagnetic linear drive is connected to a thrust member which is vertically slidable in a vertical tubular-bag-forming and filling machine. Transverse welding dies are provided below the filling tube, which dies present mechanical resistance to the thrust member. The thrust member presses the ends of the [longitudinally] welded tube against the transverse dies, whereby bottom-seam sealing is accomplished. Because of the very high speed of movement of the thrust member when it is introduced and removed, there is minimal effect on the filling process [i.e. minimal delay].

The flaps of open folding boxes can be bent over and glued shut employing a device (Claim 11) wherein the movable part of the electromagnetic linear drive is connected to a flap-closing implement, wherewith a conveyor belt is provided which transports open folding boxes to the site of the flap-closing implement. Different such implements serve as closers of side flaps or cover flaps, depending on

the orientation of the implement. Where the open boxes lie flat, it is advantageous if the cover-flap-closing implement acts vertically toward the conveyor belt, and the side-flap-closing implement(s) act(s) parallel to the conveyor belt surface.

A box-closing device wherein the movable part of an electromagnetic linear drive is connected to a gripping implement is particularly advantageous in situations where the box has a separate cover handled as a blank. Gripping elements are useful for manipulating and transporting other box parts as well.

The actual excursion of the movement of a gripping implement, a transverse welding die, or other implement or component, can be chosen over a wide range of possibilities, if (Claim 12) the movable part of one electromagnetic linear drive is connected to the driving part of a second electromagnetic linear drive, wherewith the movable parts of the linear drives are translationally movable in directions which are mutually perpendicular and coplanar. Such a combination of two linear drives enables additive combinations of mutually perpendicular accelerations or movements. When one of the linear drives is displaced by a certain distance, the second linear drive is shifted parallelly by that distance. The resultant excursion of a closing/welding implement driven by this combination of linear drives is thus limited only by the constraint of the limits of linear excursion of the individual drives. E.g., the combination can be used to move a transverse welding die through a path in the shape of a parallelogram, a circle, or an ellipse.

A closing and sealing apparatus according to Claim 13 can be used for rapid application of adhesive to the flaps of a box cover, and rapid pressing of the resultant adhesive-bearing flaps against the corresponding box. At least one adhesive-application nozzle is provided along a conveyor belt, and downstream thereof a top-application station is provided which has at least one flap-folding implement is provided which is moved vertically by means of an electromagnetic linear drive. In this way, a cover is applied to an upwardly open box, using a cover blank which is bent-over (formed) in

place on the box, and secured by adhesive.

If the inventive device [for influencing the product or packaging] is in the form of a separating (or cutting) device, one can achieve accelerations [of the cutting implements] which are twenty times the earth's gravitational acceleration. These accelerations are attained by the movable part or other driven part of an electromagnetic linear drive (relative the the driving part of said drive). The cutting or separating implement is driven by said movable part (or other driven part). The drive mechanism driving said implement, and the kinematics thereof, may be very simple. High positional and time accuracies can be achieved. Packaging material can be separated out or cut at such high speed that the operation is easy to accomplish while the packaging material is being conveyed; accordingly, the inventive cutting/separating apparatuses can be used to realize high speed packaging machines.

A strip film can be cut along a straight line transverse to its direction of transport, with the use of a cutting device comprising a cutter movable tangentially to said strip, under the influence of straight-line guide means (Claim 15). Because the strip is cut extremely quickly, it can be cut while in motion, wherewith the cut may not be perfectly perpendicular to the direction of movement. It is particularly useful in the film-transport region of a tubular-bag-forming and filling machine to be able to cut the strip film quickly and to engage a new strip film [(or segment of strip film)] at the location of the cutting of the old strip film.

If a bend edge which serves to produce a bend [(which may be a momentary bend)] in a strip film is provided, which bend edge extends parallelly to the guide means, wherewith the strip film is slightly stressed

-- Col. 8 --

at the locus of the bend edge, and if a cutting blade of the strip cutter is slidable along said bend edge, a more reliably straight-line line of cutting is achieved.

Bags which have been formed, filled, and sealed on a tubular-bag-forming and filling machine can be extremely rapidly separated from the [body of the] strip film if (analogously to Claim 16) the cutting implement is a punching knife, and said punch knife is translationally movable in a recess in a transverse [welding] die in said bag forming and filling machine.

The cutting/separating device may be in the form of a hole punch (Claim 17) disposed in the transverse [welding] die of a tubular-bag-forming and filling machine, wherewith said punch is applied to punch a hole in the top seam of a tubular film bag. The welding die has welding surfaces for producing a top seam and a bottom seam. Guide means are provided to guide the hole punch perpendicularly to the welding surface for the top seam, and perpendicularly to (and through) said seam. The guide means may have a recess through which a rod-shaped punching part is moved. The hole punch should be disposed centrally along the length of the transverse welding die. Thereby, if the tubular film extends centrally between the transverse dies, the resulting hole will be located centrally along the length of the top seam.

If a part of the electromagnetic linear drive is rigidly connected to a support of one of the transverse welding dies, and the other part of said drive is movable with respect to said first part and is rigidly connected to the hole punch, then the transverse dies can be moved mutually toward and away from each other independently of the movement of said linear drive [for driving the hole punch].

A cutting device will engage the packaging material more accurately if the cutter has a toothed configuration with the teeth pointing in the cutting direction. If, e.g., the material being cut is a film, the teeth grip and hold said film during the cutting operation.

If the device [for acting against the product or packaging] is a device for advancing of packaging materials (Claim 18), the packaging material can be moved very rapidly.

A combination of two mutually perpendicular accelerations can be

achieved with a combination of two electromagnetic linear drives according to Claim 19, wherewith the driving part of one linear drive is rigidly connected to the movable part of the other linear drive, and wherewith the movable parts of the linear drives are movable in directions which are mutually perpendicular and coplanar. With this arrangement, e.g., a displacement effected by one linear drive can serve to move the second linear drive translationally parallelly by the displacement distance. Thus the combination of the two linear drives can be used to move a device for advancing of packaging materials in a path executed by said advancing device which path is arbitrary [in the plane in question], being limited only by the maximum excursions of said linear drives.

The device for advancing of packaging materials may comprise a conveyor belt (Claim 20), wherewith advancing elements

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are provided on said conveyor belt, and wherewith the movable part of a linear drive acts on the surface of an advancing element and in the conveying direction of the conveyor belt.

The conveyor belt may be, e.g., a rotary (endless) belt employed to convey a series of open empty bags to a filling station and thereafter to a bag closing and sealing station, with the belt advancing stepwise. The belt can be driven in the entirety of its (stepwise) movement by a linear drive. If said linear drive is connected to a generator of vibratory signals via an electrical line (Claim 21), the movable part of the linear drive may be vibrated (or moved in rapid small steps) during its forward movement, whereby, e.g., bags which are being conveyed while containing a product which is subject to being compacted by shaking can be subjected to appropriate shaking, to achieve higher product densities.

If the device for advancing of packaging material comprises a film advance means associated with a vertical tubular-bag-forming and filling machine, wherewith the movable part of the linear drive is movable parallelly to the center axis of the filling tube, it is possible to advance the tubular film (and therewith the strip film)

very rapidly in said machine. Stepwise advance is employed. The film advance means engages the tubular film, after which the linear drive moves said film advance means in the film advance direction, and then the film advance means releases the tubular film, and the linear drive moves the film advance means back [to repeat the cycle]. If a combination of two linear drives acting in mutually perpendicular directions (as described above) is employed, the film advance means may engage the tubular film frictionally in that said film advance means is pressed against the filling tube (with the tubular film in between), by adction of the second linear drive radially toward the filling tube. With this film advance arrangement, as well as with the film advance arrangement described previously, advantageously the device for engaging and subsequently releasing the packaging material (the tubular film) is a vacuum nozzle associated with a vacuum pump. The film is engaged with the application of vacuum, and may be released by relaxation of the vacuum to atmospheric pressure (or even with the aid of overpressure). In this connection, a valve may be provided to alternately connect the vacuum nozzle to a vacuum or to atmospheric pressure (or overpressure).

With the use of an embodiment of the inventive apparatus according to Claim 23, box blanks can be separated out [from a stack or the like]. Here the device for advancing of packaging material comprises the tip of a separator for separating [box] blanks, which tip is mechanically connected to the movable part [of a linear drive], and said tip is movable toward (and against) a stack of flat box blanks which stack may be contained in a special storage and feed enclosure (magazine). With each forward movement of the movable part of the electromagnetic linear drive, the said tip forces a box blank out of the magazine.

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If the movable and driving part of the linear drive coincide, the drive may be positionally fixed and employed to move, e.g., a rod relative to the drive. Alternatively, the entire drive may be moved, in conjunction with guide means, which guide may comprise, e.g., a

positionally fixed rod. If a plurality of movable and driving parts, e.g., a plurality of linear drives, are employed, one can devise a very rapidly reacting conveying device analogous to a bucket conveyor. If the successive driving parts (and the linear drives) are equidistantly spaced, and are operated stepwise, then with each step a linear drive [(with its cargo)] is accurately moved to a next work station. Each such moving/driving part (thus each such movable linear drive) may bear a platform for accommodating packaging materials which are to be conveyed. The platform may bear vertically oriented detents extending transversely to the conveying direction (and perpendicularly to the platform), to prevent the packaging material from being dislodged from the platform under high accelerations and decelerations.

If the device for advancing of packaging material comprises a thrust member connected to a vacuum nozzle, which thrust member is movable into (and through) a forming recess, the device can be used to rapidly form boxes by pressing a flat box blank into such a recess. If adhesive has been pre-applied to the box blank, an adhesively fastened box can be thereby produced. The function of the vacuum nozzle (as described above) is to engage an individual box blank, hold the blank on the thrust member, and subsequently release the blank after the box-forming has been accomplished. The box blanks can be conveyed from a storage enclosure for box blanks by the use of a second linear drive, whereby the linear drive and thrust member can be moved back and forth between said storage enclosure and the forming recess.

Labels can be transferred employing, as the device for advancing of packaging material (Claim 24), a device for conveying labels. If the label-conveying device has linear engaging means for the labels, individual labels can be engaged and removed from a storage enclosure. If the engaging means are planar, having a generally planar surface for engaging the labels, the conveying device can be used to convey the labels parallelly. If the conveying device comprises a vacuum nozzle connected to a vacuum pump, which nozzle opens out at the

engaging surface, vacuum can be employed to hold a label to the engaging surface, wherewith, e.g., the label can be moved past an adhesive-applying nozzle and then pressed onto an object to be packaged.

If the device for advancing of packaging material

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comprises a horizontally movable plate, above which a product delivery location is disposed, products arriving from above can be delivered into a storage receptacle disposed on said plate. In a situation where the product is delivered at a fixed location, a linear drive can be used to advance the plate stepwise by one product thickness (or width) per step, thereby forming a row of product units in the receptacle. By use of a second linear drive acting horizontally in a direction perpendicular to that of the first drive, a plurality of mutually parallel rows can be formed in the receptacle. If the product units are generally flat, e.g. [flattened] tubular bags, the product units can be arrayed in an overlapping (fish-scale) orientation in the receptacle, by employing a step size which is less than the width of the product unit [but greater than the thickness of said unit]. A conveyor belt can be operated analogously to produce a row of product units in fish-scale orientation on said belt.

If the device for influencing the product to be packaged is a conveying (or guiding) device (Claim 25), the product can be introduced very rapidly to the packaging process.

If the moving part is connected with a thrust member, and the thrust member acts directly on the product (Claim 26), the product can be moved along the conveying (and/or guiding) device without the need for costly components. A sufficient mechanism comprises a simple rigid connection between the thrust member and the movable part.

If the device for conveying (and/or guiding) the product is a conveyor belt (Claim 27), this device can be employed to introduce the product to a packaging station and to guide the product in connection therewith.

A conveying device [i.e. electromagnetic linear drive] may be

used to deflect a conveyed product at a 90° angle. In particular, two mutually transversely disposed conveyor belts may be employed, wherewith a thrust member is provided which can be moved transversely to the supplying conveyor belt and onto the removing conveyor belt, such that product arriving on the supplying belt is pushed by the thrust member onto the removing belt. Because the [thrust member] can be moved very rapidly, the process can be carried out with the belt[s] being continuously in motion.

The embodiment of a conveying device according to Claim 28 provides a so-called "linear distributor". The thrust member can be moved transversely to the [supplying] conveyor belt and transversely to a series of other mutually parallel conveyor belts, wherewith product is moved by the thrust member from one conveyor belt to another. The conveying may be total or may be selective (e.g. every third product unit); and each product unit may be transferred to any desired destination belt.

If the thrust member operates parallelly to and on the

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conveyor belt, and can be moved laterally and vertically with respect to the conveyor belt, the [linear drive] device can be employed as a "product synchronizer" to adjust the spacing of products in a row [(i.e. on the conveyor belt)] to a constant spacing. The respective positions of the product units can be determined for control purposes by a position-sensing device. After the thrust member executes an adjustment it is moved laterally or vertically away from [the product unit in question] and placed in position for the next adjustment.

In a vertically oriented filling shaft, in order to deliver product to a fixed elevation in the shaft from a product-supply device disposed above the shaft, a thrust member having adjustable elevation may be employed in the shaft, analogously to Claim 29, in conjunction with an elevation-measuring device to measure the fill level of product in the shaft. The measuring device may comprise, e.g., an infrared or ultrasound sensor. After each product unit is unloaded into the shaft, the signal from the sensor controls a downward

movement of the thrust member by the thickness of said product unit.

If the device for conveying (and/or guiding) the product is a conveying channel, and the movable part [of the linear drive] is movable transversely to the conveying direction and connected to the device for conveying (and/or guiding) the product, the conveying channel can be vibrated by the electromagnetic linear drive. With this arrangement, the vibration frequency will be relatively high; the result is particularly uniform product flow.

In a vertical filling tube (particularly in a tubular-bag-forming and filling machine), the falling of product units (particularly product pieces of large size) through the tube can be facilitated by increasing the cross section of the tube during the falling. However, during bag welding, when no product is falling, for proper bag manufacturing the cross section must be reduced to normal. These adjustments can be carried out if the filling tube is bifurcated in the vertical direction (i.e. said filling tube having two lateral parts), wherewith at least one of said parts is horizontally movable, being connected to a horizontally movable part of an electromagnetic linear drive. The filling tube parts are mutually separated immediately before the free fall, and are moved back together immediately after said free fall.

In an embodiment in which the movable part and driving part [of the linear drive] coincide; a closed-loop guideway is provided as the device for conveying (and/or guiding); and a platform is provided as the upper part of the movable part [of the linear drive], one is provided with transport carriages which travel around and are supported by the guideway. Products can be carried out the platforms.

Various drive means may be provided for conveyor belts.

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E.g., the conveyor belt may operate around two rolls, one of which rolls is driven by an electromagnetic linear drive via a connecting-rod mechanism which engages the roll via an pivot at the edge region of the roll. The driving part of the linear drive drives the movable part of the linear drive, which drives the connecting-rod mechanism,

which drives the roll and thereby the conveyor belt. In an economical variant of this, the movable part of the linear drive is a part of the rotary conveyor belt itself. The driving part is positionally fixed, and drives the conveyor belt directly and linearly.

A conveying apparatus can be used to produce an overlapping (fish-scale, or roof shingle) orientation of product units in a row, wherewith a conveyor belt is employed to convey and guide the product. A second conveyor belt is disposed above said first belt, to deliver product to a delivery position disposed above said first belt. The greater the speed of the upper conveyor belt compared to that of the lower conveyor belt, the smaller the distance between product units on the lower belt; by appropriate adjustment of the speeds, the desired overlapping product orientation on the lower belt can be achieved.

To prevent a [generally flat] bag from bulging into a more rotund shape, a thrust member can be employed to press against a bag and hold it against a wall as the bag is slid along said wall. With this arrangement, the thrust member is connected to the movable part of a linear drive, whereby the thrust member is directed toward [and urged against] said wall while at the same time said movable part is moved parallelly to the wall. The movement of the [thrust member] along guide means parallel to the wall is driven by a linear drive wherein the drive part and driven part coincide. The bag is held compressively in flattened form, between the thrust member and the wall. To facilitate constancy of the flattened configuration of the bag which is being transported, compression means are provided on the movable part [of the linear drive bearing the thrust member], which compression means act transversely to the guiding direction, to urge the bag against the wall. The compression means are devised such that the thrust member exerts a constant compressive force on the bag which it is holding. If the compression means themselves comprise an electromagnetic linear drive, the development of the compressive force for holding the bag (and the release of the compressive force for releasing the bag and engaging a subsequent bag) can be achieved very rapidly. If the guide means are configured in a closed loop, the next

bag can be engaged smoothly by the thrust member without special acceleration (or deceleration) of said thrust member. The bags conveyed along the wall can be delivered directly into a storage enclosure, if a feed device for the storage enclosure is provided at the end of the wall. Each time an incoming bag is received, the storage enclosure is advanced by the width of one bag, so that the bags are deposited in a row in said enclosure.

If the device for conveying (and/or guiding) the product consists of the end of a tubular film on a vertical tubular-bag-forming and filling machine,

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and a product-advancing device operating by an expelling principle is connected to the movable part [of a linear drive], wherewith the direction of movement of the product-advancing device is downward (or a component of the velocity of said device along the compressed tubular film is downward) (Claim 30), the product-advancing device can be used to further accelerate the downward movement of the product. The product is accelerated in that the product-advancing device tends to compress the tubular film (at least partially), downstream of the falling product. This has the further benefit of efficiently expelling the product from the region of the tubular film which is to be sealed by transverse welding.

If the device [for conveying and/or guiding the product] is a volumetric dosing device employing a sliding mechanism (Claim 31), a high speed of dosing can be achieved.

If the volumetric dosing device has at least one dosing chamber disposed below at least one outlet of a reservoir [for product], wherewith said chamber(s) is/are slidable by at least one mechanism suitable therefor, and if the the dosing chamber is delimited in the direction of the sliding by at least one slidable delimiting piece, wherewith said sliding piece(s), by sliding, close(s) off or open(s) up said outlet(s) (Claim 32), then, when the sliding mechanism is positioned appropriately such that the dosing chamber communicates with the reservoir outlet, product can flow into the dosing chamber;

and, with further sliding of the sliding mechanism, product can be delivered to the region below [said chamber], through a pass-through opening in a terminal piece disposed under the the sliding mechanism, which terminal piece has at least one pass-through opening at a location which is displaced, in the sliding direction, with respect to the reservoir outlet. If two dosing chambers are provided, one dosing chamber can undergo filling while the other is emptying out into the pass-through opening.

If the dosing chambers and the delimiting piece are embodied in a single component, the filling and emptying of the dosing chambers can be effected by simple sliding of this component. If the dosing chambers are disposed above the terminal piece, with the component containing the dosing chambers being disposed above component containing (or embodying) the terminal piece, then in order to deliver the product one need only slide the upper component, and mass inertia of the delimiting piece does not inhibit extremely rapid sliding of said component.

The sliding excursion of a sliding mechanism including dosing chambers may particularly be straight-line or circular. A straight-line excursion may be achieved in simple fashion without high mass-inertia [lit., "a high moment of mass-inertia"] by means of simple rigid connection of an electromagnetic linear drive to the sliding mechanism. [For a circular movement,] a sliding mechanism in the form of a "rondell" (disc having a series of axial throughgoing openings disposed at angular intervals around the center axis of the disc and generally radially equidistant from said center axis) driven by a movable part [of a linear drive] may be provided, with stepwise movement through respective rotational angles, wherewith the drive is facilitated by radially outwardly directed engaging projections

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which are engaged by said movable part. This may be mediated by, e.g., a catch mechanism which fixes the angle of step-advance of the "rondell".

Product coming directly from a dosing chamber or via a pass-

through opening may be delivered directly into a tubular bag which is being fabricated in the vertical filling tube of a tubular-bag-forming and filling machine disposed below the above-described sliding mechanism. A plurality of such filling tubes may be provided. Two parallelly disposed filling tubes of a so-called "twin machine" may be provided; or two or more separate packaging machines may be provided. Because of its ability to deliver doses of product alternately into a set or succession of filling tubes, the inventive apparatus is suitable for delivering product to a plurality of packaging machines.

A thrust member movable from above into a dosing chamber by the movable part of an electromagnetic linear drive (Claim 33) can be employed to expel a product dose established in said chamber; and further to accelerate said falling dose until it reaches the lower part of a filling tube. Thereby product doses can be introduced into packaging at high speed.

If valve means (comprising one or more retaining flaps or the like) are disposed under the bottom opening of a filling tube, which flaps are connected to the movable part of an electromagnetic linear drive, the filling tube can be very rapidly closed-off and reopened. If the tube is closed-off immediately after product delivery [into the tube], late-falling product moving through the tube will be retained by the flaps and will not be released until the next product delivery step. Such late-falling product causes problems, e.g., when welding the top seam of a tubular bag in a vertical tubular-bag-forming and filling machine, because product caught in the weld seam can cause a defective (leaking) seam.

In an embodiment according to Claim 34, at least one guide means for the movable part [of an electromagnetic linear drive] is connected to said movable part; and the guide means comprise a sliding bearing having at least one coated or specially treated, friction-reducing sliding surface on said guide means and/or on an element which slides along said guide means.

This facilitates highly accurate positioning of the movable part in directions perpendicular to its sliding direction. The low

friction in the sliding bearing allows rapid movement [of said movable part]. The essentially massive components [of the guide means] may be fabricated in steel, thereby affording the desirable properties of steel in a component, particularly in a component which interacts with other components. The sliding surfaces may be selected according to the particular situation.

If the guide means and the associated sliding element are comprised of steel,

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and if the sliding surfaces are comprised of ion-implanted steel, the known desirable properties of steel are retained, the components (guide and sliding element) can be fabricated inexpensively, and the sliding surfaces have high frictional wear-resistance. Suitable ions for the ion-implantation in the sliding surfaces are aluminum ions.

The sliding surfaces may be comprised of a thin coating of diamond-like carbon [sic] applied to steel. A coating thickness of several nanometers is sufficient and is economical. Such coatings are highly wear-resistant and have a very low coefficient of friction.

Another possibility for the sliding surfaces is polytetrafluoroethylene with metallic admixtures [sic]. The polytetrafluoroethylene contributes low friction and the metallic admixtures contribute wear resistance.

If a respective guide associated with a slidable element is provide on each side of the movable part [of a linear drive] and parallel to the direction of movement of said movable part, wherewith side guides are equidistant from said movable part, one can achieve high guiding accuracy, with the guides accommodating forces which act perpendicularly to said direction of movement. In a simple and reliable embodiment, said guides are upright rods or the like, and the sliding elements are mutually interconnected -- and are connected to said movable piece -- by a crossmember. The movable part is connected to the crossmember at the center of the crossmember. Such crossmembers may also be used to synchronize other machine subassemblies with the said sliding elements, by connecting said

subassemblies to said crossmember.

Where a sliding element is relatively wide, according to a simple and inexpensive embodiment of the inventive apparatus, the guides disposed on each side of the movable part [of a linear drive] and parallel to the direction of movement of said movable part are upright rods which extend through the sliding element. This guide arrangement is very robust and compact. The movable part and driving part of the electromagnetic linear drive may coincide, with the movable part being a sliding element, wherewith the driving part may act against a third rod-like upright disposed centrally between the guide uprights, which third upright [also] extends throught the sliding element. This arrangement where the drive is itself disposed centrally in the sliding element that the drive does not exert tilting moments or torques on said sliding element.

The apparatus may be used for conveying over small or large distances if the movable part is horizontally slidable and bears a platform rigidly connected to its top side. The platform may carry its cargo directly or via a container fixed to the platform.

In the embodiment according to Claim 35,

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the linear drive acts via a reduction transmission. The reduction ratio may be, e.g., a value in the range of 2. The acceleration is reduced by this ratio, but even thus reduced is very high. If it is desired to ultimately apply a particular [relatively large] force, this may be accomplished by a linear drive which develops a relatively low force, in conjunction with the reduction transmission. Because the cost of a linear drive increases disproportionately with increasing direct output force, substantial savings can be achieved by minimizing the value of said output force. A further advantage of a lower-force linear drive is compactness, which may be valuable in designing the machinery into which the drive is to be incorporated.

The driving part [of the linear drive] may be positionally fixed relative to the movable components and articles, e.g. may be rigidly fixed to a machine frame, or may be [(e.g. controllably)] movable with

respect to said frame, wherewith all the resultant movements will be relative to said driving part.

A transmission according to Claim 36 [, comprising rigidly interconnected coaxial discs of different diameters,] has the advantages that it is simple, inexpensive to fabricate, and suitable for high accelerations. The reduction ratio is determined by the ratio of the diameters of the discs; it can be changed quickly and in simple fashion by changing discs.

A very simple and robust transmission device is provided by an arrangement in which the movable part [of a linear drive] is disposed perpendicularly to a guide means, and is connected via a linking mechanism to a component which is slidable along the guide means. The movable part is guided with high positional accuracy, and inertial forces which must be overcome are minimized. If, when such a transmission is in its starting position for an acceleration process, the angle between the linking mechanism and the guide is at most 60°, the initial force component in the direction of the guide at the start of the process is relatively high.

Friction in a transmission device according to Claim 36 is minimized if:

-- the engaging device is a rotating surface;

-- two additional rigidly interconnected discs are disposed axially parallel to the first pair of rigidly interconnected discs and at a distance therefrom; and

-- a belt is provided which rotates around the smaller-diameter discs, and a second belt is provided which rotates around the larger-diameter discs.

In order to prevent slippage between the belt and a rotating surface, the rotating surface and belt may have interengaging teeth.

Another robust configuration for a transmission device is provided by a tong-type (or pantograph-type) lever mechanism, which may comprise two crossed lever elements the ends of which are connected to two sliding components via articulations. The components are slidable along a guide. The movable part of the electromagnetic

linear drive acts against the ends of the levers to spread or close the lever mechanism, wherewith when the mechanism is spread the said sliding components are moved apart along the guide, and when the mechanism is closed said components are moved together along the guide.

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Depending on structural design considerations, the movable part [of the linear drive] may be installed in the apparatus such that said movable part is moved perpendicularly to or parallel to the guide. If installed perpendicularly to the guide, the movable part may be connected to the respective crossed lever ends via connecting rods, wherewith the linear drive is positionally fixed. The connecting rod [lit., "connecting rods"], and the levers of the pantograph-type mechanism, transmit the force of the linear drive over a relatively long distance, transversely to the guide and along the guide. If the movable part and the linear drive are installed parallel to the guide, the said crossed levers can be interconnected at approximately their midpoints via an articulation, wherewith one of said levers is connected to the driving part [of the linear drive] via a pivot and to the other crossed lever via a connecting rod (which connecting rod may be rigidly connected to said movable part).

This mechanism is particularly suitable for transmitting relatively large forces with small deflections of the components. The reduction ratio [(if any)] is determined by the lever arms (force arm and load arm) of the crossed levers, derived from the precise location of the articulation between the two levers; in principle, the reduction ratio may be varied by changing the location of the articulation along just one of the two levers.

A thrust member may be connected to a transmission mechanism, which thrust member is employed to push a product along a path. Such an arrangement may be used, e.g., to insert individual bags into folding boxes, to accomplish "bag-in-box" packaging.

In a transverse welding mechanism for a tubular-bag-forming and filling machine, each of the welding dies may be connected to a

respective transmission mechanism, wherewith back and forth movement of the movable part [of one or more linear drives] causes the dies to move together and apart, to accomplish the welding.

If the inventive apparatus is in the form of a device for adjusting the elevation [of an object], the entire holding mechanism of a transverse welding die, along with an associated linear drive [for horizontally applying said die], can be moved vertically by the linear drive of said elevation-adjusting device. By appropriate adjustment of the movements of the two linear drives, the welding dies can be moved through an essentially infinite variety of paths.

The invention will be described hereinbelow with reference to the drawings in which exemplary embodiments are illustrated.

Fig. 1 is a [schematic] lateral view of a conveyor belt operating in generally stepwise advances, which belt is driven by an electromagnetic linear drive;

Fig. 2 is a [schematic] lateral view of a part of a bagging machine [for bags with internal reinforcing boxes] which shows a

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deposition station for box blanks and a movable thrust member disposed above the box blank, which thrust member is moved into and in the filling tube of said bagging [and boxing] machine by means of a linear drive;

Fig. 3 is a [schematic] lateral view of the subject of Fig. 2 with the thrust member having been pushed into the filling tube and the box blank having been pushed into a tubular film, wherewith a produced bag assembly [with interior box] is shown;

Fig. 4 is a [schematic] perspective view showing a thrust member which can be moved from above into a dosing device provided with a filling tube which extends below said dosing device;

Fig. 5 is a [schematic] lateral view (with partial vertical cross section) of a filling tube showing portions of falling product, wherewith a thrust member is provided for accelerating [and compressing] the product portions during their fall, which thrust member is shown in an upper position and also (dashed lines) in a

lower position;

Fig. 6 is a [schematic] lateral view showing a thrust member which serves as a bag inserter, which thrust member is driven by two linear drives oriented at a mutual 90°, to insert a bag into an open folding box;

Fig. 7 is a [schematic] lateral view illustrating the principle of detection of defective product by a sensor, wherewith said defective product is deflected from a stream of free-falling product by means of a thrust member;

Fig. 8 is a [schematic] plan view illustrating the principle of detection of defective product by a sensor, wherewith said defective product is ejected from a conveyor belt by means of a thrust member which is part of a removal system;

Fig. 9 is a [schematic] perspective view illustrating the principle of detection of imperfectly closed boxes by a sensor, wherewith an ejector removes said boxes; and also illustrating insertion means for leaflets;

Fig. 10 is a [schematic] plan view of a welding device comprised of transverse dies, in a tubular-bag-forming machine, with an electromagnetic linear drive;

Fig. 11 is a [schematic] lateral view showing the filling tube of a tubular-bag-forming machine having subsystems for forming and welding of a

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tubular film, wherewith two lateral fold-forming implements are provided which are driven by respective electromagnetic linear drives;

Fig. 12 is a [schematic] lateral view with partial cross section, showing a folding implement for bag seams, which implement is driven by an electromagnetic linear drive and acts against the seam of a bag;

Fig. 13 is a [schematic] lateral view showing a thrust member which is reciprocally movable in the axial direction in a filling tube of a tubular bag-forming and bagging machine, which thrust member acts against the end of a tubular film and against transverse [welding] dies;

Fig. 14 is a [schematic] perspective view of an open folding box and a tubular bag, along with two closing devices for lateral [box-]flaps, a closing device for the cover flap [of the box], and a device for inserting bag [into the box], all four of which devices are driven by respective electromagnetic linear drives;

Fig. 15 is a [schematic] plan view with partial horizontal cross section, of a welding device employing transverse welding dies, which device is driven by a pressure-transfer device which is influenced by an electromagnetic linear drive;

Fig. 16 is a [schematic] lateral view showing a gripper driven by one of two orthogonally acting electromagnetic linear drives at a [box]top application station;

Fig. 17 is a [schematic] lateral view of [three] flap-folding implements at a [box]top application [(or fixing)] station, each of which implements is driven by a respective electromagnetic linear drive;

Fig. 18 is a [schematic] lateral view of a transverse [welding] die which is movable horizontally and vertically by means of electromagnetic linear drives;

Fig. 19 is a [schematic] perspective view of a cutting device for cutting of strip material, wherein the cutting implement, driven by an electromagnetic linear drive, is slidable along a bend edge which serves to produce a bend [(which may be a momentary bend)] in a strip film;

Fig. 20 is a [schematic] perspective view showing a cutting device wherein the cutting implement is in the form of a punch knife which is movable through a transverse [welding] die of a vertical tubular-bag-forming machine

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and is driven by an electromagnetic linear drive;

Fig. 21 is a [schematic] plan view of a cutting device in the form of a hole punch which is guided perpendicularly to the welding surface of a transverse welding die, by guide means;

Fig. 22 is a [schematic] lateral view showing a conveyor belt having advancing surfaces (or members) on its underside which can be engaged by the movable part of an electromagnetic linear drive;

Fig. 23 is a [schematic] lateral view of a vertical tubular-bag-forming and filling machine with film-advance means which advance means can be moved between an upper and a lower position by means of a linear drive;

Fig. 24 is a cross sectional view through line A-A of Fig. 23;

Fig. 25 is a [schematic] perspective view of a device for separating box blanks which acts on one blank in a stack of such blanks, said action being under the influence of a linear drive;

Fig. 26 is a [schematic] perspective view of a plurality of linear drives, each of which bears a platform for accommodating packaging material and can be moved along a guide means;

Fig. 27 is a [schematic] lateral view of a thrust member having vacuum nozzles for engaging box blanks whereby said thrust member moves said blanks under the influence of a linear drive, [into and through] a forming recess for forming of the boxes, which recess is [initially] disposed below said thrust member;

Fig. 28 is a [schematic] lateral view of two label-conveying devices, each movable by a respective linear drive, wherewith one of the conveying devices has a generally linear member which engages the label, and the other label-conveying device has a generally planar holding member (or surface) and is provided with a vacuum nozzle;

Fig. 29 is a [schematic] lateral view of an arrangement with a plate and an associated storage receptacle which are horizontally movable by linear drives, with said receptacle being disposed below a product delivery location;

Fig. 30 is a [schematic] plan view of a conveying apparatus having two mutually perpendicularly oriented conveyor belts for conveying product,

and further having a thrust member which is driven by an electromagnetic linear drive and which pushes product from one conveyor belt to the other;

Fig. 31 is a [schematic] plan view of a conveying apparatus having three parallel conveyor belts for conveying product, and further having a thrust member according to Fig. 30;

Fig. 32 is a [schematic] plan view of a conveying device having a conveyor belt and two thrust members which thrust members are movable in the conveying direction and serve to achieve equidistant product spacing;

Fig. 33 is a lateral view of part of the conveying device according to Fig. 32;

Fig. 34 is a [schematic] lateral view, with partial vertical cross section, of a conveying device having a thrust member the elevation of which thrust member is adjustable in a filling shaft, and further having a [fill-]level measuring device and bag supply device;

Fig. 35 is a [schematic] lateral view of a conveying channel for conveying granular product, which channel is subjected to vibration by means of an electromagnetic linear drive;

Fig. 36 is a cross sectional view of the subject of Fig. 35, through line A-A of Fig. 35;

Fig. 37 is a [schematic] lateral view, with partial vertical cross section, of the essential components of a vertical tubular-bag-forming and filling machine wherein the vertical filling tube comprises two lateral parts one of which is horizontally movable by an electromagnetic linear drive;

Fig. 38 is a [schematic] plan view of a closed-loop track bearing movable carriages which carriages have platforms and move along (around) said track;

Fig. 39 is a vertical cross section showing a different embodiment of a movable carriage [traveling] on a track;

Fig. 40 is a [schematic] lateral view showing a conveyor belt which operates around two rolls, one of which rolls is driven by an electromagnetic linear drive via a connecting-rod mechanism;

Fig. 41 is a [schematic] lateral view showing two conveyor belts operating at different speeds, for producing a row of overlapping product units (fish-scale orientation),

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wherein each conveyor belt is driven directly by a corresponding electromagnetic linear drive;

Fig. 42 is a [schematic] lateral view showing a conveying device in which the movable part of an electromagnetic linear drive is movable parallel to a wall, with the aid of guide means, wherewith a bag is compressively held between said wall and a thrust member which thrust member is connected to said movable part [of said drive];

Fig. 43 is a [schematic] lateral view of a portion of the subject of Fig. 42 wherein the guide means here are closed-loop guide means;

Fig. 44 is a [schematic] lateral view of a variant of the essential subject of Fig. 42, in an apparatus for loading of bags into trays (or similar receptacles);

Fig. 45 is a [schematic] lateral view of the welded end of a tubular film in a vertical tubular-bag-forming and filling machine, wherein expelling means for advancing or removing product are driven by an electromagnetic linear drive;

Fig. 46 is a [schematic] vertical cross section of an apparatus for dosing of flowable product, comprised of a reservoir vessel having two bottom outlets, further comprised of a volumetric dosing device and a sliding mechanism which mechanism is slidable by means of an electromagnetic linear drive, for delivering product into a filling tube;

Fig. 47 is a [schematic] vertical cross section of an apparatus analogous to that of Fig. 46, but having only one outlet [on the reservoir] and having two filling tubes;

Fig. 48 is a [schematic] perspective view of an apparatus for dosing of flowable product, wherein a sliding mechanism in the form of a so-called "rondell" (rotary disc having a series of axial throughgoing openings disposed at angular intervals around the center axis of the disc and generally radially equidistant from said center axis) is provided, wherewith product is delivered to the filling tube of a vertical tubular-bag-forming and filling machine, and wherewith also provided are a thrust member which is movable downward into a dosing chamber, and retaining-valve means for closing off the bottom opening of the filling tube;

Fig. 49 is a [schematic] lateral view of a device for moving an element, in the form of a device for adjusting the elevation of said element, comprised of a centrally disposed electromagnetic linear drive wherewith guide rods having

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friction-reducing sliding surfaces are disposed on both sides of said linear drive;

Fig. 50 is a [schematic] cross sectional view of a guide rod having a separate external layer which provides a peripheral sliding surface;

Fig. 51 is a [schematic] cross sectional view of a guide rod having an external sliding surface which has been produced by ion implantation in steel;

Fig. 52 is a [schematic] plan view of a device in which the movable part and driving part of the electromagnetic linear drive coincide, and comprise the element which is to be moved, wherewith the driving part acts on a central rod disposed between two lateral rods, wherewith the central rod serves as the drive base and the lateral rods serve as guides;

Fig. 53 is a cross section through the element to be moved according to Fig. 52, with the section line being transverse to the direction of movement;

Fig. 54 is a [schematic] lateral view of a horizontally slidable element in a device analogous to that of Fig. 52 except that the two lateral guide rods are not provided and the slidable element has a platform rigidly connected to it;

Fig. 55 is a [schematic] lateral view of a drive device (with transmission) for welding dies, wherein an electromagnetic linear drive is disposed in a position which achieves a reducing transmission ratio, or alternatively ([linear drive shown in] dashed lines) in a position in which the mechanical ratio is 1:1, wherewith the device is further comprised of two toothed bars (racks) acting on a small spur gear and another toothed bar acting on a larger spur gear;

Fig. 56 is a [schematic] lateral view of a drive device (with transmission) for welding dies, comprised of two pairs of discs each of which pairs consists of a smaller disc rigidly [and coaxially] connected to a larger disc, wherewith a first belt rotates around the two smaller discs and a second belt rotates around the two larger discs;

Fig. 57 is a [schematic] lateral view of a transmission arrangement similar to that in Fig. 56 but embodied in an apparatus employed for elevation adjustment;

Fig. 58 is a [schematic] lateral view showing the movable part of an electromagnetic linear drive which movable part moves perpendicularly to a guide means, whereby two components

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which are slidable along said guide in mutually opposite sliding directions are connected to said movable drive part via a linking mechanism;

Fig. 59 is a [schematic] lateral view of a drive device (with transmission) having a tong-type (or pantograph-type) lever mechanism for sliding two components along a guide means, wherewith the movable part of an electromagnetic linear drive moves perpendicularly to said guide means;

Fig. 60 is a [schematic] lateral view of a different drive device (with transmission) having a tong-type (or pantograph-type) lever mechanism, wherein the movable part [of the linear drive] is moved parallel to the guide means;

Fig. 61 is a [schematic] lateral view of a drive device (with transmission) analogous to that of Fig. 56, for moving a thrust member against a bag, and for pushing said bag into a folding box; and

Fig. 62 is a [schematic] lateral view of two discs (pulleys) of different diameters which are rigidly interconnected and are rotatable around a [common] axis, wherewith each of the discs can engage a respective smooth endless belt (belts not shown).

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In a packaging apparatus 1, an electromagnetic linear drive 3 (Fig. 1) is provided which serves as a device 2 which advances a product 8 which is to be packaged. The electromagnetic linear drive 3 is comprised of a movable part 4 and a part 5 which drives the movable part 4. The movable part 4 can be moved (accelerated, uniformly translated, and decelerated) by the driving part 5 in the opposite direction [or reciprocally], by means of electromagnetic force, and said movable part 4 is rigidly connected to a thrust member 6. The apparatus also has a conveyor belt 9 which serves as a device 7 for conveying and/or guiding the product 8 being advanced; belt 9 extends around two wheels (10, 11), and bears a plurality of product-accommodating means 12 each of which has a rod 14 extending downward from it. A respective bag 13 is transported on each accommodator 12. The thrust member 6 has a slot in it whereby it engages a respective rod 14 and causes the conveyor belt to move one step-length further. In addition to the abovementioned electromagnetic linear drive 3, a second electromagnetic linear drive 15 is provided which is comprised essentially of a movable part 16 and a driving part 17. The two linear drives (3, 15) are rigidly interconnected wherewith the driving part of the first linear drive 3 is connected to the movable part 16 of the second linear drive 15, such that the second linear drive 15 moves the first linear drive 3 toward (or away from) the conveyor belt

9, causing the thrust member 6 to engage (or disengage from) the rod 14. Thus the thrust member 6 on the linear drive 3 is moved

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in a path which describes a parallelogram. After the linear drive 3 advances the conveyor belt 9 by one step-distance the linear drive 3 is retracted away from conveyor belt 9 by a movement of the second linear drive 15, such that the thrust member 6 disengages from the rod 14, following which the movable part 4 of linear drive 3 is moved under the next rod 14 and is caused to engage said next rod 14 by the second linear drive 15, and the next step-advance of the conveyor belt 9 ensues. With this embodiment, the thrust member 6 acts indirectly through the device 7 to move (or guide) the product 8 on the accommodator 12 [lit., "on the product 8"].

In the exemplary embodiment illustrated in Figs. 2 and 3, the thrust member 6 acts directly on the product to be packaged 8. The device 7 which moves (or guides) the product 8 is here the filling tube 18 of a vertical bagging machine 19. The thrust member 6 is connected via a rod 20 to the movable part 4 [lit., "3"] of a linear drive 3 whereby member 6 is movable from above in the axial direction in the filling tube 18. A deposition station 21 (Fig. 2) for individual box blanks 22 is disposed directly above the filling tube 18. The thrust member 6 engages the box blank 22 and presses it into the filling tube 18 with [partial] folding of the box elements, and inserts the box bottom-first (Fig. 3) into the tubular film 23 which surrounds the filling tube 18. A punching knife 24 cuts off the tubular film 23, producing an open-bottomed bag 25 which is stiffened by the box blank 22. The bottom 26 of the bag 25 is sealed by transverse welding dies 27. Longitudinal welding of the tubular film 23 is accomplished by a longitudinal welding die 28. The film is transported by film advance means 29. The film sheet 30 is formed into a tubular shape 23 by means of a forming jig 31.

In the exemplary embodiment according to Fig. 4, the thrust member 6 is movable from above into a dosing device 32. The linear drive 3 drives a rod 20 associated with the thrust member 6, which rod

20 constitutes the movable part 4. The dosing device 32 [lit., "33"] has a plurality of dosing chambers 33. When a [gate] device 34 is opened by means of a linear drive 35, the product 8 present in a dosing chamber 33a is released into free fall whereby it falls through a funnel 36 into the filling tube 18. The thrust member 6 acts through the open dosing chamber 33a and into the filling tube 18, thus [generally] over the entire space 37 through which the product 8 passes downward. Other linear drives (38, 39) rotate the dosing device 32 stepwise, and open and shut retaining flaps 40 which prevent the product 8 from trickling out of the filling tube 18.

In the exemplary embodiment according to Fig. 5, a thrust member 6 which is configured as a sieve 41 fitted to the interior of the filling tube 18 of a packaging apparatus performs its sieve function in said tube. Clusters of product components 42 are accelerated and compressed by the thrust member 6 in the course of their "free fall". Two electromagnetic linear drives (43, 44) are responsible for the movement of the thrust member 6. The linear drive 43 is disposed parallel to the filling tube 18. The other linear drive 44 is disposed radially with respect to the filling tube 18. The

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filling tube 18 has an axially extending slit 45. A tangential opening (46, 47) is provided at each respective end of the slit 45. The thrust member 6 is connected to the movable part 49 of the radially disposed (with respect to the filling tube 18) linear drive 44 by means of a rod 48 which extends in the slit 45. Following a downward movement, the thrust member 6 is removed radially from the filling tube 18 through the opening 47, by operation of the linear drive 44, is moved upward by operation of the linear drive 43, and is inserted into [and through] the upper opening 46 by operation of the linear drive 44, where it can then accelerate and compress the next product component cluster 42. The forced compression of the product clusters emables faster, more consistent, and more reliable packaging of the product.

In the exemplary embodiment according to Fig. 6, the surface of a

horizontally moving conveyor belt 50 serves as a device 7 for moving the product 8. The thrust member 6 is movable horizontally, by means of an electromagnetic linear drive 51, in a direction transverse to the direction of movement of the conveyor belt 50. The linear drive 51 itself is movable in a direction parallel to the conveying direction, by means of a second linear drive 53. By these means, the thrust member 6 driven by the linear drive 51 inserts the product 8 (in the form of a tubular bag 54) into an open box 55 of the folding-box type. In this process, the thrust member 6 acts toward a vertically disposed detent 52 which serves as a detent for the box 55. During the insertion, the second linear drive 53 moves the thrust member 6 in accompaniment with the conveyor belt 50, and [thereafter] the first linear drive 51 moves the thrust member 6 back in the direction opposite to the conveying direction, to re-emplace thrust member 6 for insertion of the next bag 54.

In the exemplary embodiment according to Fig. 7, a horizontally movable thrust member 6 is provided which can intervene in the path of falling product 56, whereby defective product 57 can be deflected from a stream of free-falling product and into a funnel 58 associated with a disposal container 59. The linear drive 60 reacts based on the signal from a sensor 61 which employs a measuring beam 62 to detect defective product 57. The [main] means of conveying and guiding the product 8 to be packaged in this example is the [main] path of the falling product.

In the exemplary embodiment according to Fig. 8, a thrust member 6 which is driven by an electromagnetic linear drive 63 in a horizontal direction transverse to the conveying direction of a conveyor belt 64 serves to eject defective product 57 from the conveyor belt 64 into a disposal container 59. The defective product 57 is detected by the measuring beam 62 of a sensor 61.

In the exemplary embodiment according to Fig. 9, two electromagnetic linear drives (66, 67) are provided which are horizontally oriented and act transversely to a conveyor belt 65. The thrust member 6 of one of said linear drives (66) is in the form of

the head 68 of a device 69 for inserting leaflets 70 or the like, which have been

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deposited at a leaflet deposition station 71, into respective open boxes 55 of the folding-box type. The conveyor belt 65 then conveys the boxes 55 containing the leaflets 70 to a closing station (not illustrated), where the boxes are closed. If a box 55 passes through the closing station and still has not been properly closed, it is detected by the measuring beam 62 of a sensor 61 and is ejected from the conveyor belt 65 by the second linear drive 67.

A sealing (or closing) device 101 (Fig. 10) is comprised essentially of a device 100 in the form of a sealing mechanism 102 with drive means 103 in the form of an electromagnetic linear drive 104, said drive 104 having a movable part 105 and a driving part 106 which drives the movable part 105. The mechanism 102 is comprised of a rod 107 and transverse dies 109 connected to said rod 107. The dies 109 serve as transverse welding die means 110 for top- and bottom seam welding on a vertical tubular bag packaging machine. The transverse dies (109, 109) are moved together (and back apart) by relative movement of the driving part 106 and movable (driven) part 105.

According to another exemplary embodiment (Fig. 15), the movable part 105 of an electromagnetic linear drive 104 is connected with a piston 112 which moves in a pressure-transmission device 111. Each of the transverse welding dies (109, 109) of a welding device 110 is connected to a respective piston (113, 114), which pistons are also movable in the pressure-transmission device 111. The device 111 is substantially pressure-sealed and contains a gas 105. When the piston 112 driven by the linear drive 104 is moved, the pistons (113, 114) are either advanced or retarded [(or retracted)], depending on the gas pressure, wherewith the dies (109, 109) are moved together toward each other or are moved mutually apart.

In the exemplary embodiment according to Fig. 11, two lateral-fold-forming implements (116) are provided on a transverse seam-welding device 110. Each of these implements 116 is driven by an

electromagnetic linear drive 104. Flat film sheet 107 undergoes forming by means of a forming jig 118 to produce a tubular film 119 around a filling tube 124. Film transport means 120 serve to advance said [tubular] film, and welding dies 109 horizontally weld shut said film [to form bags which do not yet have lateral folds]; the longitudinal seam 121 of the tubular film 119 is welded by a longitudinal-seam-welding device 122. The lateral-fold-forming implements 116 form lateral folds 123 in the tubular bags which are being formed.

In the exemplary embodiment according to Fig. 12, the movable part 105 of an electromagnetic linear drive 104 is in the form of an implement 125 which causes the folding-over of the [transverse] seam of a bag. The bag 127 (with end seam 128) is conveyed to the site of action of the folding implement 125 by a conveyor belt bearing cup-shaped compartments 126. The seam is folded-over by a movement

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of the movable part 105 relative to the driving part 106.

In the exemplary embodiment according to Fig. 13, the movable part 105 of an electromagnetic linear drive 104 is connected to a thrust member 129 which is reciprocally movable in the vertical direction in a filling tube 124 of a vertical bag-forming and bagging machine 130. Transverse [welding] dies 109 are provided under the filling tube 124 which dies provide mechanical resistance against the thrust member 129. Between successive filling processes, the thrust member 129 is moved against the bottom 131 of the tubular film 119, thereby enabling one of the transverse dies [(or die combinations)] 109 which are rotated around the shafts (132, 132) to weld the bottom flap 128 against the tubular film 119.

In the exemplary embodiment according to Fig. 14, three sliding implements 133 for manipulation of flaps [of a box], and a sliding insertion implement 134 for inserting a bag [in a box], are driven by respective linear drives 104. Each such drive 104 has a respective movable part 105 which is connected to the respective sliding implement (133, 134). A conveyor belt 135 is provided for conveying

open folding boxes 136 to the site of operation of the flap-manipulating sliding implements 133. One of said implements 133 serves as a cover-flap-manipulating implement 137 which acts vertically with respect to the [(horizontal)] conveyor belt so as to fold-over the cover flap 138. Two of the sliding implements 133 serve as laterally-acting flap-manipulating implements 139 which act parallelly with respect to the surface of the conveyor belt 135 so as to close the lateral flaps 140.

In the exemplary embodiment according to Fig. 16, the movable part 105 of an electromagnetic linear drive 104 is connected to a gripper 141 which is a suction-type (vacuum) gripper 142 which serves to grip a blank 143 of a [foldable] cover 144 for covering an open-topped box 145. The [external] upper edge regions of the box 145 are sprayed with adhesive by adhesive-application nozzles 146. The driving part 106 of the linear drive 104 is vertically oriented, and is connected to the movable part 147 of a second electromagnetic linear drive 148 which latter is horizontally oriented. The driving part 149 of said second linear drive 148 is positionally fixed. With this arrangement, the first linear drive 104 can be driven in horizontally parallel fashion by the second linear drive 148, and the gripper 142 can be moved in a combined movement wherewith the gripper grips a [boxcover] blank 143 at a supply location (not shown), moves said blank to a location above a box 145, and applies said blank onto said box.

Fig. 18 illustrates a combination of two electromagnetic linear drives (104, 148), analogous to that of Fig. 16, for a transverse [welding] die 109, thereby enabling said die to execute various [complex] movements.

In the embodiment shown in Fig. 17, the conveyor belt 135 of Fig. 16 transports the box 145 bearing a boxtop blank 143 to a boxtop-application station 150, where flap-folding implements 151 [lit., "141"] are provided which are moved vertically by means of electromagnetic linear drives 104 so as to fold-over the flaps 152 of the

boxtop 144 and press said flaps against the adhesive-bearing upper edge regions of the box 145.

In a cutting apparatus 201 (Fig. 19), comprised of a cutting implement 203 and a drive 204 for said implement 203, the device 100 for acting against a packaging material 202 comprises the drive 204 in the form of an electromagnetic linear drive 205 (which may be referred to as a "linear motor") having a movable part 206 and a driving part 207 which drives said movable part. Said movable part 206 is connected to said cutting implement 203. The cutting implement 203 is a tangentially-acting cutting implement 209 for strip material, which in the Figure acts horizontally on a strip film 208.

The strip-cutting implement 209 is guided along a rectilinear guide means 210, associated with the film-advance system 211 of a bag-forming and bagging machine (machine not shown). A bend edge 212 is provided on a bar 213 of rectangular cross section, which edge extends parallel to the guide 210 and serves to effect a slight bend [(which may be only momentary)] in the strip film 208. A blade 214 on the strip-material cutter 209 is slidable along the bend edge 212, and severs the strip film along said edge. Such a strip-cutting implement 209 is particularly used when supply rolls 215 are changed.

In the exemplary embodiment according to Fig. 20, the cutting implement 203 is in the form of a jagged-edged punch knife 216 with jagged edge 217 wherein the punching teeth are directed in the direction of the cutting. The punch knife 216 is slidable in an opening 219 in a transverse [welding] die 218 of a tubular-bag-forming machine (machine not shown), so as to cut through a tubular film 220. A top seam and a bottom seam (222, 223) are formed on the tubular film 220 by relative movement of two mutually opposed transverse weld dies (218, 221) at least one of which is hot. During this welding process, the punch knife 216 severs the tubular film 220, thereby separating the bag (which has been previously filled) from the remainder of the tubular film. The punch knife 216 is connected to a movable part 206 of an electromagnetic linear drive 205, which part 206 is driven by a

positionally fixed driving part 207.

In the exemplary embodiment according to Fig. 21, the cutting device 203 comprises a hole punch 225 in a transverse welding die 218 of a tubular-bag-forming machine (machine not shown), which die 218 has welding surfaces (226, 227) which produce a top seam 222 and a bottom seam 223, respectively (analogously to Fig. 20, q.v.). The hole punch 225 is guided transversely to (and through) the top seam 222 by guide means 228. When punching the hole in the packaging material 202, the hole punch 225 penetrates a short distance into the continued guide means 228 in the second transverse welding die 221, wherewith the guide 228 is in the form of an opening 229 and the punch 225 is in the form of a mandrel 230 which mandrel is rigidly connected to the movable part 206 of an

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electromagnetic linear drive 205. Said movable part 206 is driven by a driving part 207 which is rigidly connected to the support 232 of one of the transverse dies (218) via a member 231. The movable part 206 of drive 205 is movable with respect to said driving part 207 and is rigidly connected to the hole punch 225. The hole punch 225 is disposed centrally with respect to the length [(top to bottom in Fig. 21)] of the transverse dies (218, 221), and has a toothed configuration 217.

An apparatus 301 (Fig. 22) for controlled conveying of packaging material is comprised of a device 100 for receiving (engaging) the packaging material, in the form of device 303, and a device 304 for advancing the received packaging material, the motive device 304 is an electromagnetic linear drive 305 (aka "linear motor"), comprised essentially of a movable part 306 driven by a driving part 307. The movable part 306 can be linked to the device 303 for receiving the packaging material, which device 303 is in the form of a conveyor belt 308 having advancing surfaces [or elements] 309. The movable part 306 of the linear drive 305 acts on such an advancing element 309 of the conveyor 308 in the conveying direction of said conveyor, thereby advancing the packaging material (not shown) disposed on the conveyor.

The conveyor 308 [lit., "378"] is supported by rolls 310. A total of two electromagnetic linear drives (305, 311) are supplied, wherewith the driving part 307 of the first linear drive 305 is rigidly connected to the movable part 312 of the second linear drive 311. The movable part 306 of linear drive 305 and the movable part 312 of linear drive 311 are movable mutually orthogonally in a plane [which plane is generally perpendicular to the conveyor plane]. When the movable part 312 is retracted toward the driving part 313 of drive 311, the entire drive assembly 305 up to and including the advancing member 314 is also retracted. When subsequently the movable part 306 is retracted [sic] with respect to the driving part 307, the advancing member 314 is moved rightward. Then when the linear drive 313 is actuated [in the advancing direction of said drive], the advancing member 314 is moved upward toward the next advancing element 309, and the conveyor belt 308 can then be moved one step leftward by actuating the linear drive 305, which drive 305 is connected by electrical line 315 to a generator of vibratory signals 316 whereby the linear drive 305 is operated in a vibratory manner so as to [vibratorily] compress a compressible product which is conveyed, in its packaging, on the conveyor belt 308.

In the exemplary embodiment according to Figs. 23-24, the device 303 for advancing the

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packaging material 302 comprises a film advance means 317 associated with a vertical tubular-bag-forming and filling machine 318. The advancer 317 acts with respect to the filling tube 319. The movable part 306 of the linear drive 305 is movable in a path parallel to the center axis 328 of the filling tube 319. The actual implements 303 for engaging the packaging material are vacuum nozzles 320 associated with a vacuum pump (pump not shown). The packaging material 302 consists of a strip film 321 which is formed into a tubular film 323 via a forming jig 322 which film is welded longitudinally by a longitudinal sealing die 324. To advance the film, the advancer 317

is moved from an upper position (solid lines in Fig. 23) to a lower position (dashed lines in Fig. 23) by a linear drive 305. During this advance, the tubular film 323 is held and moved downward by the vacuum nozzles 320, which are subjected to vacuum (suction). When the nozzles 320 are in the lower position, a positive gage-pressure is applied to them instead of a vacuum, and thereby the tubular film 323 is released from the advancer 317, subsequently to which the advancer is moved back to its upper position. The difference in elevation between the upper and lower position corresponds to the length of a tubular bag 325. The bag-forming and filling machine 318 operates stepwise. While the advancer 317 is being moved upward, the tubular film 323 is transversely welded with the aid of transverse welding dies 326 and is cut by means of a punching knife 327. The tubular bags 325 which are produced are filled with doses of content material via the filling tube 319.

In the exemplary embodiment according to Fig. 25, the device 303 for conveying packaging materials 302 is the tip 329 of a separator 330 for separating [box] blanks. Said tip 329 is mechanically connected to the movable part 306 of a linear drive 305. The driving part 307 of drive 305 moves tip 329 toward a stack 331 in an enclosure (magazine) (not shown) for storing flat box blanks 332, wherewith in each movement against said stack 331 said driving part [i.e. said conveying device] separates a box blank 332 from the stack 331.

In the exemplary embodiment according to Fig. 26, the movable part 306 and driving part 307 of the linear drive 305 are the same. Both parts (306 and 307) are suspended on (or along) a guide means 333 in the form of a bar 334. A plurality of such linear drives 305 are disposed along the fixed guide 333; in particular, the driving parts 307 (and linear drives 305) are disposed at equidistant intervals. The actual advancing implement 303 is a respective platform 335 fixed to the top side of each movable part / driving part (306/307), which platform 335 serves to accommodate packaging material (not shown). Each platform 335 has vertical support means [336] extending perpendicular to it for securing said packaging material.

In the exemplary embodiment according to Fig. 27, the device 303 for advancing packaging material 302 comprises a thrust member 337 which bears vacuum nozzles 338 on its underside, for picking up and depositing box blanks 332. The thrust member 337 can be moved vertically downward into a forming recess 339, by operation of the driving part 307 of a linear drive 305. By movement of a second linear drive 311 along a bar 340, the linear drive 305 and thrust member 337 can be displaced simultaneously in the horizontal direction. With the aid of a vacuum, the thrust member 337 engages an adhesive-bearing box blank 332 and transports said blank into the position shown in Fig. 27 by horizontal movement, whereafter said member 337 presses said blank downward through the forming recess 339. As the adhesively fastened box falls downward out of the forming recess 339, the thrust member 337 is moved back to its receiving position to receive another box blank.

In the exemplary embodiment according to Fig. 28, the conveying devices 303 provided are devices (341, 342) for conveying labels, wherewith one such device (341) transfers the labels 343 to the other device (342). The first label-conveying device 341 has a generally linear member 344 which slides a single label 343 out of a label-storage enclosure or cartridge 345. The second label-conveying device 342 has a generally planar holding member (or surface) 346 for further conveying the labels 343, and is provided with a vacuum nozzle 347 associated with a vacuum pump, wherewith said nozzle 347 opens out into the planar holding member 346. The holding member 346 holds label 343 by vacuum, and presses said label against an adhesive-bearing package 348. The label is released from member 346 by application of positive gage pressure to the nozzle 347.

In the exemplary embodiment according to Fig. 29, the device 303 for advancing the packaging material 302 comprises a horizontally slidable plate 349 disposed under a product delivery location 350 at which location 350 tubular bags 325 are delivered from a conveyor belt 351 into a storage receptacle [352] via a chute 353. To form a first

row of tubular bags 325 [in said receptacle], immediately before the arrival of each incoming bag 325 the plate 349 (and thereby the receptacle 352) is moved rightward by the distance of one bag thickness, with the aid of the device 304 for moving the packaging material 303, which device is in the form of the linear drive 311. The driving part 313 of drive 311 drives a movable part 312. A [second] linear drive 305 is disposed between the movable part 312 and the plate 349. The driving part 307 of drive 305 is rigidly connected to the movable part 312 of drive 311. When the deposition of a row of tubular bags 325 in the receptacle 352 has been completed, linear drive 305 moves the plate 349 and the

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storage receptacle 352 by one bag width in a direction transverse to the first row, to enable deposition of a second row of tubular bags 325 parallel to the first row.

A conveying device 401 for product 402 to be packaged (Fig. 30) is comprised of a device (100, 403) for moving the product 402, and a device 404 for guiding the product being moved. The motive device 403 comprises an electromagnetic linear drive (linear motor) with a movable part 406 driven by a driving part 407. Movable part 406 is movable over the guiding device 404. A thrust member 408, which acts on the product 402, is rigidly connected to movable part 406. The device 404 for conveying and guiding the product is comprised of two mutually perpendicularly oriented conveyor belts (409, 410), the first of which 409 supplies [product to] the second 410. The thrust member 408 is movable transversely to the supplying conveyor belt 409, and acts toward and onto the receiving conveyor belt 410, whereby an incoming product 402 is very rapidly pushed off of conveyor belt 409 and onto conveyor belt 410. After each transfer operation, the thrust member 408 is equally rapidly retracted to its initial position.

In the exemplary embodiment according to Fig. 31, a thrust member 408 is movable transversely to a conveyor belt 411 as well as to two additional conveyor belts which are parallel to belt 411, wherewith

thrust member 408 also distributes product from conveyor belt 411 [to said other conveyor belts].

The conveying device 401 may also be in the form of a product "synchronizer" 414 (Figs. 32-33) [sic -- reference numeral 414 does not appear], which slides product 402 being conveyed on conveyor belts (415, 416, 417, 418), in the conveying direction, so as to achieve equidistant spacing between successive product units 402. Two thrust members (419, 420) are movable over and parallel to the conveyor belt 417, and their elevation with respect to belt 417 is adjustable. Sensors
(421, 422) are provided at or near the conveying device for determining the position of the products 402. Conveyor belt 417 operates at a speed substantially greater than the speed of conveyor belt 416, to facilitate the increasing of the spacing between successive incoming products 402; this feature is particularly important in the event of incoming products units 402 being initially very closely spaced. The surface of conveyor belt 417 allows sliding of product 402 in the conveying direction on said surface with the aid of the first thrust member 419 in a manner such that successive product units 402 on conveyor belt 418 are equdistantly spaced. The sliding action is carried out corresponding to the parameters measured by the sensor 421, and is [also] controlled via sensor 422. The thrust members
(419, 420) function in alternation. To accomplish a sliding, an electromagnetic linear drive (405, 422) wherein the driving part 407 and movable part 406 coincide is slidingly moved along a guide bar (423, 424). After completion

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of such an excursion, the thrust member (419, 420) is raised upward [(out of the plane of Fig. 32)] by an electromagnetic linear drive (425, 426, respectively) in which also the driving part 407 and movable part 406 coincide, wherewith the driving part 407 is moved along a guide bar (427, 428, respectively). The thrust member (419, 420), now raised, is passed over the product 402 and is returned to a

starting position, where it engages the next product unit 402.

In the embodiment according to Fig. 34, the inventive conveying device has a thrust member 408 the elevation of which is adjustable inside a filling shaft 429 by means of a linear drive 405. The height of fill in the filling shaft 429 is measured by a fill-level measuring device 430 employing an ultrasound sensor 431. Product 402 is delivered to the filling shaft 429 via a chute 434, from a rotary (or circulating) product supply device 432 disposed above said shaft 429. The fill-level measuring device 430 and linear drive 405 serve to maintain a constant [receiving] height of the upper surface 433 of the topmost product unit 402 in the filling shaft 429, such that each falling product unit 402 falls through the same falling distance in the same falling time.

In the exemplary embodiment according to Figs. 35-36, a device 404 for conveying a product 402 is provided in the form of a conveying channel 435. The movable part 406 of an electromagnetic linear drive 405 is movable transversely (vertically) with respect to the conveying direction and is rigidly connected to the device 404. Drive 405 vibrates the conveying channel 435, facilitating the provision of a uniform product stream 436 to a receptacle 437.

In the exemplary embodiment according to Fig. 37, a device 404 for conveying a product 402 is provided in the form of a filling tube 438 bifurcated in the vertical direction (i.e. said filling tube having two lateral parts). The tube 438 is part of a vertical tubular-bag-forming and filling machine 439. One of the two filling tube parts (440, 441) is horizontally movable by a linear drive 405, facilitating the dense packaging of product 402 having relatively large pieces in the [tubular] film 442. The filling tube 438 is widened only during the free fall of the product 402. After the fall is completed, the filling tube part 441 is moved back toward (and against) the other filling tube part 440, and the tubular film 443 is welded (longitudinally by longitudinal sealing/welding die 444 and transversely by transverse sealing/welding dies (445, 446)). The film is cut with a cutter 447, and fresh film is fed from a film supply

roll 448.

In the exemplary embodiment according to Fig. 38, the linear drives 405 each have a movable part 406 and driving part 407 which coincide. The conveying device 403 is in the form of a closed-loop track 449 or the like. The upper region 450 of each movable part 406 is in the form of a platform 451 and serves to convey the product (not shown).

According to another embodiment (Fig. 39), a guide rail 452 is provided in the track 449 which rail 452 has coding 453 for individual carriages and polewise control 454, to facilitate

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accurate location-to-location movement of the movable part 406.

In the exemplary embodiment according to Fig. 40, a conveyor belt 455 operates around two rolls (456, 457), one of which rolls 456 is connected to the movable part 406 of an electromagnetic linear drive 405, via a connecting rod linkage 460 wherein a connecting rod is connected to the edge region 458 of said roll 456 via a pivot 469. The linear drive 405 thereby drives the conveyor belt 455.

In the exemplary embodiment according to Fig. 41 a device 401 [lit., "4"] for conveying product 402 is provided in the form of a rotary conveyor belt 461, disposed below a second conveyor belt 462. Product is transferred from the upper belt 462 to the lower belt 461 by free fall, at a transfer station 463. The speed of the upper conveyor belt 462 is greater than that of the lower conveyor belt 461, resulting in an overlapping, "fish-scale" type of arrangement of the product units 402 on the lower conveyor belt 461. The conveyor belts (461, 462) are driven by linear drives (405, 405) wherein the movable part 406 of the drive is a part 464 of the conveyor belt (461, 462) itself. The position of an incoming product unit 402 is determined by a sensor 465 employing measuring beam 466, and [the signal from said sensor] is employed to adjust the speed of the lower conveyor belt 461 to suitably accommodate the incoming product 402.

In the exemplary embodiment according to Fig. 42, the movable

part 406 of an electromagnetic linear drive 405 is movable parallel to a wall 467 and along a guide means 468. Movable part 406 bears [(but does not drive)] a thrust member 408 which is directed toward the wall 467. Pressing means 469, in the form of an electromagnetic linear drive 470, are provided on the movable part 406 which pressing means act transversely to the direction of movement [of the drive 405]. Said pressing means serve to compressively hold a product 402 against the wall 467 via the thrust member 408. Excess air is expelled from bags 471 coming from a tubular-bag-forming and filling machine by means of air-expelling implements 472; the bags are then welded shut with the aid of transverse sealing dies (445, 446), and by application of knife means 447 said bags are cut away from the [continuous] tubular film 443 [from which they have been formed]. A flattened form of the bags is maintained and ensured (dashed lines -- note especially the configuration of the thrust member 408) as they are conveyed along the wall 467 to a system of mutually "counter-rotating" conveyor belts (473, 474). An advanced position of the thrust member 408 is shown in dashed lines. After the bag is passed on [to said downstream belts (473, 474)], the thrust member 408 is returned via guide means 468 to a ready position for engaging the next bag 471. The guide means 475 [(variant of the guide 468)] may also be rotary (Fig. 43).

In the exemplary embodiment according to Fig. 44, the bags 471 are delivered in a flattened state, to a receptacle 478 which has been moved, by a conveyor 477, to the delivery point at the end 476 of a wall 467 of a feed device. The bag 471 is first received from a system of counter-rotating chain conveyors (479, 480), passes to a conveyor belt 481 and into a shaft 482 between a

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moving wall [i.e. rotary conveyor] 467 and a thrust member 408 which is movable along a guide means 468. The pressure force on the bag 471 in shaft 482 is provided by a spring 483 disposed on a linear drive 485 which is movable along a guide means 484, which spring acts against the moving wall 467.

In the exemplary embodiment according to Fig. 45, the device 404

for guiding the movable product 402 is in the form of the welded [lower] end 486 of a tubular film 443 in a vertical tubular-bag-forming and filling machine (machine not shown). A device 487 [for expelling product from a region inside a tubular film by squeezing the sides of the film together while sliding down the film, or for removing product from bags by wiping or squeegee means,] is connected to the movable part 406 of an electromagnetic linear drive 405. When the linear drive 405 is actuated, its driving part 407 first moves its movable part 406 downward, wherewith the side elements 488 of the lever system 489 are pressed toward each other by means of the positionally fixed rolls 490 and the joint 491, against the force of a spring 492. The rolls 493 [act] on the side elements 488 and force said side elements together, while said side elements are pulled downward; this results in forced downward movement (or expulsion) of product 402 contained in the tubular film 443 [; and wiping-off of product 402 present on the tubular bag 443]. When the movable part 406 is moved in the reverse direction (upward) with respect to the driving part 407, the product expeller [(or remover)] 487 is opened again for the next product portion and is brought to its upper position.

In an apparatus 501 (Fig. 46) for dosing of flowable product 502, comprised of a reservoir vessel 503, a device 100 for moving the product, in the form of a volumetric dosing device 504, and a sliding mechanism 505 having a drive 506 for operating the dosing device 504, the drive 506 is an electromagnetic linear drive 507 [lit., "407"] having a movable part 508 driven by a driving part 509. The movable part 508 is rigidly connected to the sliding mechanism 505 of the dosing device 504. Said dosing device 504 has two dosing chambers (510, 511) which are slidable below two outlets (512, 513) of the reservoir 503, by means of the sliding mechanism 505. The the dosing chambers (510, 511) are delimited in the sliding direction by the delimiting pieces (514, 515), which pieces close off one of the respective reservoir outlets (512, 513) when the other outlet is being used to fill the other dosing chamber (510, 511). A pass-through

opening 517 which is parallel to but transversely displaced from the outlets (512, 513) is provided in a terminal piece 516, for delivery of product 502; product 502 falls through said pass-through opening 517 into a vertical filling tube 518 of a tubular-bag-forming and filling machine. The dosing chambers (510, 511) and the delimiting pieces (514, 515) form a single component 519 [(of unit construction)]. The sliding mechanism 505 is slidable in straight-line movement. During the filling of one of the dosing chambers (510, 511), product continues to be delivered, namely from the other dosing chamber (511, 510), into the filling tube 518.

In the exemplary embodiment according to Fig. 47, in contrast to the arrangement in the embodiment according to Fig. 46, only one outlet 512 is provided on the bottom of the product reservoir 503, and only one delimiting body 514 is provided to close off the outlet 512,

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which body 514 is disposed between the two slidable dosing chambers (510, 511). Two filling tubes (518, 518) (instead of one) are provided in the terminal piece 516 for the dosing chambers (510, 511). Product is delivered alternately to the two filling tubes (518, 518) by back and forth movement of the sliding mechanism 505.

In the exemplary embodiment according to Fig. 48, dosing chambers 510 are provided in a sliding mechanism 504 [lit., "505"] in the form of a so-called "rondell" 520 (rotary disc having a series of axial throughgoing openings disposed at angular intervals around the center axis of the disc and generally radially equidistant from said center axis), which bears radially outwardly projecting pins 521 each of which is radially associated with one of the dosing chambers 510. In back and forth movement, the movable part 508 of an electromagnetic linear drive 507 engages one of the pins 521, whereby the "rondell" 521 is advanced by a defined rotational angle. The dosing chambers 510 are filled at a supply tube 522 connected to the reservoir vessel, and after two step-advances in the filled state are disposed above the pass-through opening 517 in a terminal piece 516, whereby the dosed product is delivered into the filling tube 518 of a vertical tubular-

bag-forming and filling machine, via a funnel 523 and a tube 524. A thrust member 525 connected to the movable part 508 of an electromagnetic linear drive 507 is movable from above into the dosing chamber 510 which is disposed above the pass-through opening 517, so as to facilitate and accelerate the passage of free-falling product into said chamber 510. Two valve means (retaining flaps) (526, 527) are provided directly below the filling tube 518; these flaps can be swung so as to occlude the bottom opening 528 of said tube 518. Each of said flaps (526, 527) is connected via a respective articulation (529, 530) to the movable part 508 of an electromagnetic linear drive 507. In their closed position (solid lines), said flaps occlude the opening 528 and thereby prevent after-trickling product from disturbing the process of welding of the transverse bag seams in the tubular-bag-forming and filling machine; in their open position (dashed lines), said flaps render the opening 528 open (i.e. passable).

In an apparatus 601 (Fig. 49) for moving two elements (602, 602) by means of an electromagnetic linear drive 603, a movable part 604 of drive 603 which part 604 is connected to said elements 602 is driven by a driving part 605 of the drive 603. [Thus] the apparatus 601 is in the form of an apparatus 606 for elevation adjustment. Two guide means (607, 608) for the movable part 604 [sic -- i.e. for the movable elements 602] are connected to the movable part 604 via the elements 602 and a crossmember 616. The guide means (607, 608) comprise sliding bearing assemblies (609, 610), each of which is comprised of an upright (611, 612) comprised of steel 613 [sic], wherewith the casing 614 of said upright bears a friction-reducing sliding surface 615 (Fig. 50). Each element 602 is comprised of steel 613, and slides over the sliding surface 615 of one of the uprights (611, 612), with the aid of a throughgoing opening (617, 618). The interior surfaces of said openings (617, 618)

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also bear friction-reducing sliding surfaces 615. The movable part 604 is equidistant from the uprights (607, 608). All of the sliding

surfaces 615 have an elevated concentration of aluminum 619 (Fig. 51) which has been brought about by ion implantation into the steel 613. The aluminum concentration is at its highest in the casing 614 of the uprights (611, 612); at this locus the friction-reducing characteristic of the steel 613 is also at its maximum.

The sliding surfaces 615 may also comprise a layer of diamond-like carbon 620 deposited on the steel 613 in a thickness of c. 1 nanometer (Fig. 50). This coating has the advantages of high frictional-wear resistance and a coefficient of friction which is one of the lowest of any solid.

In the exemplary embodiment according to Figs. 52-53, the movable part 604 and driving part 605 of the electromagnetic linear drive 603 coincide, and comprise the element which is to be moved 602. The driving part 605 acts on a rod 621 disposed between two other rods (611, 612). All the rods (611, 612, 621) extend through the element 602. The center rod 621 serves to drive the element 602, with the outer rods (611, 612) serving as guide rods (607, 608) [sic]. The sliding surface 615 is present only on the outer rods (611, 612).

In the exemplary embodiment according to Fig. 54, no separate guide rods are provided; the rod 622 which passes centrally through the element 602 serves also as the guide rod 607. The driving element 605 of the electromagnetic linear drive 603 acts on said rod 622. The rod 622 has a sliding surface 615 and fits closely to the passage in the element 602. The movable part 604 is horizontally slidable, and bears an upper platform 623 which is rigidly connected to it, for conveying of goods (goods not shown). The length of the movable part 604 in the direction of movement is more than twice that of its two dimensions in the plane transverse to the direction of movement, ensuring that the element 602 has particularly good guiding characteristics as a guided element.

In an apparatus 701 for moving at least one device 702 (Fig. 55), said apparatus comprised of a drive 703 and a transmission device 705 connected to a respective device 702 by a respective linkage 704, further comprised of a further linkage 706 between the

transmission device 705 and the [(respective)] drive 703, the drive 703 constitutes an electromagnetic linear drive 707 having movable part 708 and driving part 709, wherewith the transmission device 705 is a reduction transmission 710. The driving part 709 is positionally fixed relative to the movable devices 702; two such devices 702 are provided, which are in the form of welding dies (711, 712), each of which is connected to the transmission device 705 via a connection (713, 714). The linear drive 707 drives the transmission 705 at a low mechanical ratio, although in principle a 1:1 ratio could be provided with drive 707 in the appropriate position (see drive 707 represented in dashed lines).

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The drive 705 comprises two rotatable discs (717, 718) of different diameters, which discs are coaxially (716) rotatable and are rigidly interconnected. Each such disc has along its periphery (719, 720) an engaging device 721 in the form of a rotating surface 723 which which has toothing 722. The toothed surface 722 engages toothed bars 724 which serve as [the] linkages (704, 706). The engaging device 721 of the larger-diameter disc 718 engages the linkage 706 to the drive 703; and the engaging device 721 of the smaller-diameter disc 717 engages the linkages 704 to the devices 702. The mechanical ratio is the ratio of the radii of discs 717 and 718. This enables use of a relatively low-power (and thereby inexpensive) linear drive 707 to generate the forces required. Despite the somewhat low mechanical ratio, the acceleration of the welding dies (711, 712) is extremely high. The discs (717, 718) are in the form of spur gears (725, 726).

In the transmission 705 according to Fig. 56, two additional rigidly interconnected discs (727, 728) are provided which are disposed axially parallel to the discs (717, 718) and at a distance therefrom. A smooth belt 729 passes around the small discs (717, 727); and a second smooth belt 730 passes around the large discs (718, 728). The rigid linkages 704 are connected to the rotating belt 729 via connections (713, 714). The movable part 708 of linear drive 707 is connected to the rotating belt 730 via the linkage 706 and the

connection 731.

In the exemplary embodiment according to Fig. 57, the apparatus 701 is in the form of an apparatus 732 for elevation adjustment. The transmission device 705 is analogous to the device 705 of Fig. 56. The elevation of a structure or device 702 is adjusted by a vertically oriented electromagnetic linear drive 707.

In the exemplary embodiment according to Fig. 61, a transmission device 705 analogous to the device of Fig. 56 is employed to move an implement 702, which here is in the form of a thrust member 733 connected to the transmission device 705 via a connection 734. The thrust member 733 serves to slide an article 715 (here a tubular bag 736) over a support surface 735.

The bag 736 is pushed into an open, horizontally disposed folding box 737. A vertical wall 738 on the support surface 735 prevents the box 737 from slipping out of place. The rigidly interconnected discs (pulleys) (717, 718) of Fig. 61 are illustrated in a [radial] detail view in Fig. 62; these pulleys are rotatable around a shaft 716. [(The pulleys 727 and 728 are analogously configured.)] Their rotating radial surfaces 723 have delimiting flanges 739 to facilitate guiding of the belts (belts not shown).

In the exemplary embodiment according to Fig. 58, the movable part 708 of an electromagnetic linear drive 707 is movable transversely to a guide means 740. Two components 702 are slidable along the guide 740 in mutually opposite directions. Movable part 708 is connected to the

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components 702 via a linking mechanism 741 [sic -- evidently should be "710"], comprised of an articulation 742 joining the connecting rods (743, 744) proceeding from respective articulations (745, 746) on the components (702, 702). In particular if the angle ß (beta) between the guide 740 and the rods (743, 744) is small, favorable mechanical ratios for transmission of forces can be achieved.

In the exemplary embodiment according to Fig. 59, the transmission device 705 is comprised of a tong-type (or pantograph-

type) lever mechanism 747 having two crossed lever elements (748, 749) the ends (750, 751) of which are connected to two sliding components 702 via articulations (745, 746). The components 702 are slidable along a guide 740. The movable part 708 influences the arms (756, 757) via the articulation 742, the rods (752, 753), and the articulations (754, 755). The articulations (754, 755) [i.e. the positions of said articulations] are adjustable along the lever elements (748, 749) [(namely, along the arms (756, 757))], to change the mechanical ratio. The direction of movement of the movable part 708 is perpendicular to the direction of sliding movement along the guide 740.

In the exemplary embodiment according to Fig. 60, the movable part 708 of an electromagnetic linear drive 707 is movable parallelly to the guide 740. The position of driving part 709 can be adjusted. The two lever elements (748, 749) are joined by an articulation 758. One lever element end 756 is connected to movable part 708 via an articulation 759 and a rod 706; the other lever element end 757 is connected to driving part 709 via an articulation 760. The apparatus 701 [of Fig. 60] is particularly suitable for small movements of the components 702, wherewith only small vertical displacements of the linear drive 707 are required.

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Patent claims:

1. An apparatus for packaging, comprised of a device for acting against the product to be packaged, or the packaging, or a part of the packaging; characterized in that an electromagnetic linear drive means (3, 44, 51, 60, 63, 66, 67, 104, 205, 305, 405, 507, 603, 707) is provided which has a movable part (4, 105, 206, 306, 406, 508, 604, 708) and a driving part (5, 106, 207, 307, 407, 509, 605, 709); and in that the movable part is connected to the said device (100).

2. An apparatus for packaging; characterized in that the device (100) is in the form of a device for accelerating the movement of a product to be packaged; in that a device (7) for guiding (or conveying) the product being moved is provided; and in that the movable part (4) of the electromagnetic linear drive (3, 44, 51, 60, 63, 66, 67) is connected to a thrust member (6).

3. An apparatus according to claim 2; characterized in that the thrust member (6) acts directly on the product (8).

4. An apparatus according to claim 2; characterized in that

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the thrust member (6) acts indirectly on the product (8), via the device (7) for guiding (or conveying) the product being moved (8).

5. An apparatus according to claim 2 or claim 4; characterized in that the device (7) for guiding the product being moved (8) is the filling tube (18) of a vertical tubular-bag-forming and filling machine (19).

6. An apparatus according to claim 1; characterized in that the device (100) [for influencing the product or packaging] comprises a closing (and/or sealing) mechanism (102) which is connected to the movable part (105).

7. An apparatus according to claim 6; characterized in that, in a tubular-bag-forming and filling machine, the closing/sealing mechanism (102) comprises a closing and sealing mechanism (110) employing two mutually movable transverse [welding] dies (109).

8. An apparatus according to claim 7; characterized in that two lateral-fold-forming implements (116) are provided on a transverse seam-forming device (110) which employs transverse [welding] dies; and in that the drive means (103) for said lateral-fold-forming implements (116) comprise at least one electromagnetic linear drive (104).

9. An apparatus according to claim 6; characterized in that the movable part (105) of the electromagnetic linear drive (104) is configured as an implement (125) which causes the folding-over of the seam of a bag; and in that a conveyor belt (126) bearing cup-shaped compartments is provided for transporting bags (127) having end seams (128) to the location of the implement (125).

10. An apparatus according to claim 6; characterized in that the movable part (105) of the electromagnetic linear drive (104) is connected to a thrust member (129); in that said thrust member (129) is vertically movable in a filling tube (124) of a vertically oriented tubular-bag-forming and filling machine (130); and in that transverse [welding] dies (109) are provided under the filling tube (124) which dies provide mechanical resistance against the thrust member (129).

11. An apparatus according to claim 6; characterized in that the movable part (105) of the electromagnetic linear drive (104) is connected to an implement (133) for manipulation of flaps [e.g. for closing the flaps of a box]; and in that a conveyor belt (135) is provided for supplying open folding-boxes (136) to said implement (133).

12. An apparatus according to claim 7; characterized in that the movable part (147) of an electromagnetic linear drive (148) is connected to the driving part (106) of a second electromagnetic linear drive (104); and in that the movable

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parts (105, 147) of said linear drives (104, 148) are translationally movable in directions which are mutually perpendicular and coplanar.

13. An apparatus according to claim 6; characterized in that at least one adhesive-application nozzle (146) is provided along a conveyor belt (135); in that a top-application station (150) [(e.g. for boxtop blanks)] is provided which is disposed downstream of the nozzle(s) (146) reckoned in the conveying direction; and in that at least one vertically movable flap-folding implement (151) is provided at the station (150), which implement (151) is driven by an electromagnetic linear drive (104).

14. An apparatus according to claim 1; characterized in that the device (100) [for influencing the product or packaging] is in the form of a separating (or cutting) device (203) for separating (or cutting) of packaging material.

15. An apparatus according to claim 14; characterized in that the separating (or cutting) device (203) is a strip-cutting implement (209) which is movable tangentially to a strip film (208); and in that said cutting implement (209) is guided along a straight guide means (210).

16. A cutting device according to claim 15; characterized in that the cutting device (203) is a punching knife (216); and in that said knife (216) is movable in a recess (219) in a transverse [welding] die (218) in a tubular-bag-forming and filling machine.

17. A cutting device according to claim 14; characterized in that the cutting device (203) comprises a hole punch (225) disposed in a transverse [welding] die (218) in a tubular-bag-forming and filling machine; in that said die (218) has welding surfaces (226, 227) which produce a top seam (222) and a bottom seam (223), respectively; and in that the hole punch (225) is guided perpendicularly to the welding surface (226) and perpendicularly to (and through) the top seam (222) by guide means (228).

18. An apparatus according to claim 1; characterized in that the device (100) [for influencing the product or packaging] is a device (303) for advancing of packaging materials.

19. An apparatus according to claim 18; characterized in that two linear drives (305, 311) are provided, wherewith the driving part (307) of one linear drive (305) is rigidly connected to the movable part (312) of the other linear drive (311), and wherewith the movable parts (306, 312) of the linear drives (305, 311) are movable in directions which

are mutually perpendicular and coplanar.

20. An apparatus according to claim 18 or 19; characterized in that the device (303) for advancing of packaging materials is a conveyor belt (308); in that advancing elements (309) are provided on said conveyor belt (308) [for engaging motive means of advancing said belt]; and in that the movable part (306) of a linear drive (305) acts on an advancing element (309) and in the conveying direction of the conveyor belt (308).

21. An apparatus according to claim 20; characterized in that the linear drive (305) is connected to a generator of vibratory signals (316), via an electrical line (315).

22. An apparatus according to claim 18; characterized in that the device (303) for advancing of packaging materials (302) is a film advance means (317) associated with a vertical tubular-bag-forming and filling machine (318), which advancer acts with respect to the filling tube (319); and in that the movable part (306) of the linear drive (305) is movable parallelly to the center axis (320) of the filling tube (319).

23. An apparatus according to claim 18; characterized in that the device (303) for advancing of packaging materials (302) is the tip (329) of a separator (330) for separating [box] blanks, which tip (329) is mechanically connected to the movable part (306) [of a linear drive (305)]; and in that said tip (329) is movable toward (and against) a stack (331) of flat box blanks (332).

24. An apparatus according to claim 18; characterized in that the device (303) for advancing of packaging materials (302) is a device (341, 342) for conveying labels.

25. An apparatus according to claim 1; characterized in that a device (404) for conveying (or guiding) a product (402) is provided; in that the device (100) [for influencing the product or packaging] is a device (403) for advancing of the product to be packaged (402); and in that the movable part (406) [of the linear drive (405)] is movable near (or along or over) the conveying (or guiding) device (404).

26. An apparatus according to claim 25; characterized in that the movable part (406) is connected to a thrust member (408, 419, 420), which thrust member acts directly on the product (402).

27. An apparatus according to claim 25 or 26; characterized in that the device (404) for conveying (or guiding) the product (402) is a conveyor belt (409, 410).

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28. An apparatus according to claims 26 and 27; characterized in that the thrust member (408) is movable transversely to the conveyor belt (411) and transversely to a series of other mutually parallel conveyor belts (412, 413).

29. An apparatus according to claims 26 and 27; characterized in that the elevation of the thrust member (408) is adjustable in a filling shaft (429); in that a fill-level measuring device (430) [lit., "439"] is provided for measuring the height of fill in the filling shaft (429); and in that a product supply device (432) is disposed above the filling shaft (429) and opens out into (or delivers to) said filling shaft (429).

30. An apparatus according to claim 25; characterized in that the device (404) for guiding the movable product (402) is in the form of the welded end [region] (486) of a tubular film (443) in a vertical tubular-bag-forming and filling machine; in that a product-advancing device (487) (for forcing product downward by an expelling action involving downwardly biased squeezing of the bag) is connected to the movable part (406) [of an electromagnetic linear drive (403)]; and in that the direction of movement of said product-advancing device (487), or a component of that movement, is along the compressed tubular film (443) and downward.

31. An apparatus according to claim 1; characterized in that the device (100) [for influencing the product or packaging] is a volumetric dosing device (504) comprised of a sliding mechanism (505).

32. An apparatus according to claim 31; characterized in that the volumetric dosing device (504) contains at least one dosing chamber (510, 511) which is slidable below at least one outlet (512, 513) of a reservoir (503), by means of the sliding mechanism (505); in that the dosing chamber (510, 511) is delimited in the direction of the sliding by at least one slidable delimiting piece (514, 515), wherewith the delimiting piece(s) (514, 515), by sliding, close(s) off or open(s) up the outlet (512, 513); and in that a terminal piece (516) is provided under the sliding mechanism (505), which terminal piece has at least one pass-through opening (517) at a location which is displaced, in the sliding direction, with respect to the outlet(s) (512, 513).

33. An apparatus according to claim 32; characterized in that a thrust member (525) connected to the movable part (508) of an electromagnetic linear drive (507) is movable from above into a dosing chamber (510).

34. An apparatus according to claim 1; characterized in that at least one guide means (607, 608) for the movable part (604) [of an electromagnetic linear drive (603)] is connected to said movable part (604); and in that the guide means (607, 608) comprise a sliding bearing (609, 610) having at least one

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coated or specially treated, friction-reducing sliding surface (615) on said guide means (607, 608) and/or on an element (602) which slides along said guide means (607, 608).

35. An apparatus according to claim 1; characterized in that the electromagnetic linear drive (707) acts via a linkage (706) to influence a transmission device (705) which is connected (or connectable) to a movable component [(e.g. a machine component)] (702) or article [(e.g. a product unit)] (715); and in that the transmission device (705) is a reduction transmission (710).

36. An apparatus according to claim 35; characterized in that the transmission device (705) comprises two rotatable discs (717, 718) of different diameters, which discs are coaxially (716) rotatable and are rigidly interconnected; in that each such disc has along its periphery (719, 720) an engaging device (721) for engaging a link (704, 706) which is disposed against said periphery (719, 720) at least tangentially; further in that the engaging device (721) on the larger-diameter disc (718) engages the linkage (706) to the drive (703), and the engaging device (721) on the smaller-diameter disc (717) engages the link (704) to the movable component (702) or article (715).

37. An apparatus according to claim 36; characterized in that the engaging device (721) is a rotating surface (723); and in that two additional rigidly interconnected discs (727, 728) are disposed axially parallel to the discs (717, 718) and at a distance therefrom, wherewith a belt (729) is provided which rotates around the smaller-diameter discs (717, 727), and a second belt (730) is provided which rotates around the larger-diameter discs (718, 728).

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Title: Method for delivering bulk materials in granular or pulverulent form [to certain packaging]; and apparatus for accomplishing the method.

Applicant: Vereinigte Österreische Eisen- und Stahlwerke AG, of Linz, Austria.

Named inventors: Peter Puxhandl and Guido Fastnecht [sp.?], both of Austria.

[etc.etc.]

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[etc.etc.] Nov 22, 1972

1A-3008

Specification

The invention relates to a method for delivering bulk materials in granular or pulverulent form, to a strip of film which is [or has been] formed into a flexible tube, wherein adjoining longitudinal edges are joined together, following which the thus formed and filled tube, in a generally horizontal attitude, is pinched together at two closely spaced loci transverse to the longitudinal direction of the tube, wherewith successive such pairs of [closely spaced] loci are disposed a distance apart so as to form bags [containing the said materials], wherewith

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said tube is severed between the [said two closely spaced] pinching

loci, and the film parts which are mutually abutting as a result of the pinching are mutually fixed together by welding, adhesive bonding, sewing, or the like. The invention also relates to an apparatus for accomplishing the method.

In known methods of packaging granular or pulverulent bulk materials, the flexible tube is formed first and is cut into lengths corresponding to the bags which are to be produced. The individual tube lengths are then formed into open bags by welding a cut locus. The bags are filled with a metered amount of the bulk material, and the [remaining open] end of such bags is then closed. A drawback of such known methods is that the operation is non-continuous and must be conducted in steps. During the filling, the bag must generally be held upright and expanded [(to create a cavity)] by means of relatively costly and complex devices. In order to be able to close the bag without problems it is generally necessary to aspirate interfering air from the bag before the actual closure operation. These drawbacks become particularly significant in the fabrication of large, heavy bags, because the necessary manipulations require inordinately large forces.

The abovedescribed drawbacks can be partly alleviated with the aid of another known apparatus, wherein a flexible tube is continuously formed from a strip of film, and a granular or pulverulent bulk material is continuously introduced into said tube. After the longitudinal edges of the tube [(i.e. of the strip)] are welded together, the tube is guided through the apparatus in a

generally horizontal attitude, is pinched together by sealing jaws at appropriately spaced loci, and is welded by welds extending transversely to the longitudinal direction of the tube, wherewith after the welding the tube is severed at severing loci between welds, whereby the bulk material

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is now packaged in a succession of bags which are closed in all directions. A drawback of such known apparatuses is that they are limited in the size of packages which can be accommodated -- they can be used to produce only small packages, e.g. for cosmetics, food portions, etc. The apparatuses are unsuitable for producing large, heavy bags, because they do not solve the problem of removing residua of the bulk material in the region of the pinching loci. The pinching operation itself does not remove such material, which tends to become incorporated in the welds and thereby tends to weaken the heremeticity and strength of the weld seams.

Accordingly, an underlying problem of the present invention is to eliminate the described drawbacks, and to provide a method which can be used to continuously package granular or pulverulent materials into heavy packaged units. A further underlying problem of the

generally horizontal attitude, is pinched together by sealing jaws at appropriately spaced loci, and is welded by welds extending transversely to the longitudinal direction of the tube, wherewith after the welding the tube is severed at severing loci between welds, whereby the bulk material

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is now packaged in a succession of bags which are closed in all directions. A drawback of such known apparatuses is that they are limited in the size of packages which can be accommodated -- they can be used to produce only small packages, e.g. for cosmetics, food portions, etc. The apparatuses are unsuitable for producing large, heavy bags, because they do not solve the problem of removing residua of the bulk material in the region of the pinching loci. The pinching operation itself does not remove such material, which tends to become incorporated in the welds and thereby tends to weaken the heremeticity and strength of the weld seams.

Accordingly, an underlying problem of the present invention is to eliminate the described drawbacks, and to provide a method which can be used to continuously package granular or pulverulent materials into heavy packaged units. A further underlying problem of the invention is to devise an apparatus for accomplishing said method, which apparatus has a relatively simple structure and enables rapid and problem-free delivery and packaging [of bulk materials].

Taking as the state of the art the above-described method for delivering bulk materials in granular or pulverulent form [to certain

packaging], the inventive [method] solves the described problem in that the flexible tube is severed prior to the fixing together of the film parts which are mutually superposed as a result of the pinching, and superfluous bulk material is removed from the film section between the [described] two pinching loci, by blowing, suction, or the like; and in that thereafter (and not therebefore) the film parts from which the superfluous bulk material has been removed are joined together near the pinching loci, wherewith preferably the pinching together of loci of the film is accomplished under continued vibration or jarring or the like. In contrast to known methods, in the inventive method the filled tube

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is severed between neighboring [(closely spaced)] pinching loci, after the pinching but prior to the fixing together of the film parts which are mutually superposed as a result of the pinching. This facilitates the removal of the bulk material present in the tube between the [said closely spaced] pinching loci, with the aid of blowing, suction, or the like. Thereby the subsequent fixing together of the cut film parts near the pinching loci can be accomplished reliably and without defects, in the absence of residual bulk material which can detract from the quality of the weld seam (locus of the weld or other fixing means). According to the invention the pinching together of the film parts occurs under continued jarring, vibration, or the like, which can substantially facilitate the pinching process, namely by urging essentially all of

the residual bulk material out of and away from the pinching locus.

Taking as the state of the art an apparatus comprised of a plurality of pinching jaws which pairwise engage opposite sides of the flexible tube, in conjunction with a welding device, and further comprised of a cutting device for the tube, wherewith the pinching jaws associated with each respective side of the flexible tube are movable along a guide path by means of a moving endless chain or the like, the inventive apparatus for accomplishing the described method is characterized in that each pinching jaw has disposed in it, between two mutually separated pinching ridge elements, a respective welding device comprised of two mutually separated welding heads, which welding device is mounted so as to be translatably movable toward and against the flexible tube, and said welding device is guided along a special guideway [(10)] which extends along the tube in the region of the portion of the respective [aforesaid] chain (or the like) which is near the tube, wherewith said welding device guideway undergoes a transition from a wider region to a more constricted region (with the narrowing being toward the tube), in the [(downstream)] end portion of the inlet region of the pinching-jaw guideway in which inlet region the pinching-jaw guideway is inclined toward the tube, wherewith, in both said wider region of the welding device guideway [(10)] and said more constricted region of the welding device guideway, the elements of the welding device guideway also extend parallel to the tube. In known apparatuses the pinching jaws

are in the form of so-called sealing jaws which combine a pinching jaw and a welding device. Thus these sealing jaws are used to assist in the production of weld seams at [(rather than adjacent to)] the pinching loci; with such an arrangement it is not possible to remove all undesirable, possibly interfering bulk material which will tend to become incorporated in the weld seam. In the inventive apparatus the welding devices are separate from the pinching jaws. The welding device, comprised of two mutually spaced welding heads, is mounted in the pinching jaw assembly so as to be translatable toward and against the flexible tube, and with the aid of its own welding-device guideway executes movements with respect to the pinching jaws. This relative movement requires two coordinating welding devices to be provided, one on each side of the flexible tube [(e.g. above and below the tube)], wherewith the welding heads are applied after the tube has been pinched by the pinching jaws and after the tube has been severed by the cutting device. The sequence and course of the movements are appropriately controlled by the respective guideways (and associated guide means) for the pinching jaws and welding devices. The pinching jaws are pressed against the tube via an inlet region of the pinching-jaw guideway which is inclined toward the tube; wherewith the pinching jaws pinch the tube. The application of the welding devices [(and in particular the welding heads)] occurs after the pinching of the filled tube and after the removal of debris [(particularly, residual bulk material)] from the severed region of

the tube disposed between the pinching loci of a pinching jaw [(i.e. between the pinching loci of one set of four pinching jaws consisting of two pairs of contraposed pinching jaws)]; this [timing] is effected by the transition of the guideway for the welding devices into a more narrowly spaced region.

In order to facilitate the pinching of the filled tube by the pinching jaws, according to the invention it is provided that the inlet region of the pinching-jaw guideway, in which inlet region the pinching-jaw guideway is inclined toward the flexible tube, is [(may be)] in the form of a jarring, vibrating, or shaking beam or the like.

According to a refinement of the invention, the pinching jaws are reciprocally movable, wherewith

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when the filled tube is pinched closed the pinching jaws disposed below the tube can be raised to an altitude above the center axis of the incoming tube. This inventive feature facilitates clearing of bulk material (generally already packed into the tube) from the region of the pinching loci, by gravity, thereby further facilitating the ultimate removal of such bulk material (especially pulverulent such material) by blowing or suction. Such superfluous local material, if not removed, may be detrimental to the weld seam.

The inventive method is illustrated in more detail in the accompanying drawings, with reference to an exemplary embodiment of an inventive apparatus for accomplishing the method.

Fig. 1 is a schematic lateral view of an inventive apparatus for delivering bulk materials in granular or pulverulent form [to certain packaging];

Figs. 2, 3, 4, and 5 are enlarged lateral views of various operating positions of the pinching jaws;

Fig. 6 is a (further enlarged) cross section through line VI-VI of Fig. 4; and

Fig. 7 is a (likewise further enlarged) cross section through line VII-VII of Fig. 5.

The inventive apparatus is essentially comprised of a plurality of pinching jaws 2 which pairwise engage opposite sides of a flexible tube 1. These jaws are movable along a guide path 4 by means of a moving endless chain 3. The pinching jaws 2 are supported against the guideway 4 via rollers 5. The guide path 4 for the pinching jaws 2 has an inlet section 6 which is inclined [sic] with respect to the tube [(wherewith its transversely open expanse is greater with progression in the direction toward the incoming tube)] and is in the form of a jarring-and-ramming beam (the operation of which may further [or principally] have a vibratory character), intended to guide the pinching jaws on each side against the tube so as to [rapidly] pinch the tube. The jarring-and-ramming effect, such as it is (with or without a vibratory character), facilitates the forcing out of the loose material from the region of the bag which is undergoing pinching.

Each of the pinching jaws 2 has two mutually spaced ridge elements 7 for performing a [(i.e. at least the principal)] pinching function, between which elements 7 a welding device 8 is disposed which is comprised of two mutually spaced welding heads and is mounted so as to be translatably movable in the pinching jaw 2 against the tube 1. These welding devices 8 have rollers 9 by which they are supported against their own guide paths 10 which paths 10 extend parallel to the tube in the region of the inlet section 6 of the pinching-jaw guide path 4 (the guide path for the pinching jaws 2); then, in an adjoining section the guide paths 10 undergo a transition to another section in which they are also parallel to the tube but are at a different (narrower) mutual separation. This transition region is designated with reference numeral 11 in Fig. 1. Once the pinching jaws [2] have pinched the tube together with the aid of the pinching-jaw guide path [4] in the inlet region 6, which inlet region is inclined with respect to the tube, the welding devices 8 are guided into operating position against the tube via the (progressively narrowing and eventually [substantially]) narrowed guide paths 10.

A strip film is continuously withdrawn from a supply roll 12 and is formed into a tube 1 (Fig. 1). The granular or pulverulent bulk material is continuously fed into the tube via a filling device 13. After the filling, the adjoining longitudinal edges of the film are continuously joined together by a seam welding device 14, whereby the

filled and closed flexible tube is continuously introduced into the bag-forming apparatus proper. The filled tube is engaged by the pinching jaws 2 in said bag-forming apparatus and is pinched together at two neighboring [(closely spaced)] loci transverse to the longitudinal direction of the tube, which loci are positioned based on the position of an end of the bag to be formed [(which end, as seen infra, will be at a longitudinal location approximately midway between the ridge elements (7, 7) (top of Fig. 2))]. This pinching process is shown in stages in Figs. 2 and 3. The pinched tubing sections are then severed using a cutting device 15, at a locus between the two ridge elements [7, 7], as indicated in Figs. 4 and 6. The bulk material contained in the tube between the two pinched loci is removed, e.g. via a suction device 16, to avoid interference by such material with the subsequent welding process.

The narrowing transition region 11 of the welding device guideway causes the welding heads to be moved against the film loci which are to be welded, as is clearly illustrated in Figs. 5 and 7. After the welding of the mutually contacting film loci, which advantageously may be performed with ultrasound means, bags filled with the bulk material are obtained, which filled bags can be conveyed further by a conveyor belt 17 or the like. The inventive method [and apparatus] for delivering and packaging bulk granular or pulverulent materials is not limited to small package situations; bags containg 50 or 100 kg of bulk material may be produced.

All data, information, and features disclosed in the present

document, including but not limited to the spatial relations and configurations disclosed, whether individually or in combination, are claimed as inventive to the extent they are novel over the state of the art.

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<u>Patent claims</u>:

1. Method for delivering bulk materials in granular or pulverulent form, to a strip of film which is formed into a flexible tube, wherein adjoining longitudinal edges are continuously bent upward and joined together, following which the thus formed and filled tube, in a generally horizontal attitude, is pinched together at two closely spaced loci transverse to the longitudinal direction of the tube, wherewith successive such pairs of loci are disposed a distance apart so as to form bags [enclosing said bulk materials], and wherewith said tube is severed between the [said two neighboring] pinching loci, and the film parts which are mutually superposed as a result of the pinching are mutually fixed together by welding, adhesive bonding, sewing, or the like; characterized in that the flexible tube is severed prior to the fixing together of the film parts which are mutually superposed as a result of the pinching, and superfluous bulk material is subsequently removed from the film section between the [said] two [neighboring] pinching loci, by blowing, suction, or the like; and in that thereafter (and not therebefore) the film parts from which the superfluous bulk material has been removed are joined together near the pinching loci, wherewith preferably the pinching together of loci of the film is accomplished under continued vibration or jarring or the like.

2. Apparatus for accomplishing the method according to claim 1; comprised of a plurality of pinching jaws [(2)] which pairwise engage opposite sides of the flexible tube [(1)], in conjunction with a welding device [(8)], and further comprised of a cutting device for the tube, wherewith the pinching jaws associated with each respective side of the flexible tube are movable along a guide path by means of a moving endless tensile chain [(3)] or the like;

characterized in that each pinching jaw (2) has disposed in it, between two mutually separated pinching ridge elements (7), a

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respective welding device (8) comprised of two mutually separated welding heads, which welding device is mounted so as to be translatably movable toward and against the flexible tube (1), and said welding device is guided along a special guideway (10) [(which welding device guideway (10) is not identical to the guideway (4) for the pinching jaws)], which special guideway (10) extends along the tube [(1)] in the region of the portion of the respective [aforesaid] chain (or the like) [(3)] which is near the tube, wherewith said welding device guideway [(10)] undergoes a transition from a wider region to a more constricted region (with the narrowing being toward the tube), in the [downstream] end portion of the inlet region (6) of the pinching-jaw guideway (4) in which inlet region the pinching-jaw guideway is inclined toward the tube [so as to narrow said pinching-jaw guideway's open expanse with progression downstream], wherewith, in both said wider region of the welding device guideway [(10)] and

said more constricted region of the welding device guideway, the elements of the welding device guideway also extend parallel to the tube.

3. Apparatus according to claim 2; characterized in that the inlet region (6) of the pinching-jaw guideway (4), in which inlet region the pinching-jaw guideway is inclined toward the flexible tube (1), is in the form of a jarring, vibrating, or shaking implement (beam or the like).

4. Apparatus according to claim 2 or 3; characterized in that the pinching jaws (2) are controlled (or guided) in a manner such that they are reciprocally movable, wherewith when the filled tube (1) is pinched closed the pinching jaws (2) disposed below the tube (1) can be raised to an altitude above the center axis of the incoming tube.

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